CURRENT RESEARCH ACTIVITIES

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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. Forty five 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 and Therapy, Helen and Norman Asher Center for Human Brain Imaging, The Willner Family Center for Vascular Biology, Gabrielle Rich Center for Transplantation Biology Research, Women's Health Research Center, The Joseph and Ceil Mazer Center for Structural Biology, The Center for Energy Research, 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 Ilse Katz Institute for Material Sciences and Magnetic Resonance Research, Helen and Martin Kimmel Center for Molecular Design, 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 Maurice and Gabriela Goldschleger Center for Nanophysics, 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, Center for Experimental Physics, The Mel Dobrin Center for Nutrition, The Avron Willstätter Minerva Center for Research in Photosynthesis, The M.D. Moross Institute for Cancer Research, The Kekst Family Center for Medical Genetics, The David and Fela Shapeel Family Center for Genetic Disorders Research, 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, Ida Cohen Center for Mathematics, The Dolfi and Lola Ebner Center for Biomedical Research, Clore Center for Biological Physics, Center for New Scientists, J R Center for Scientific Research, Center for Scientific Exellence 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, Veterinary Resources, and the Solar Facilities Unit.

The present scientific complement numbers about 698, including 397 academic staff, 106 long−term visiting scientists and post−doctoral fellows, and 195 research assistants directly serving the research programs. Approximately 961 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 654 and administrative and service personnel numbering 389, the total complement is approximately 2596.

Faculty of Biochemistry

Department of Biological Chemistry

Zvi Livneh, Head

The research activities of the Department of Biological Chemistry span several topics in the life sciences with overlapping interests. The common thread connecting these activities is the study of proteins in key biological processes ranging from transport across membranes and signal transduction, to gene expression and DNA repair. The department has more than 30 research groups whose activities are centered around the following five foci of interest:

1. Protein science, including protein−protein interactions, protein−ligand interactions, and evolution of enzymes.
2. Proteins involved in controlling DNA stability, repair and expression of genetic information.
3. Structure and function of ion channels, pumps and other proteins that transport solutes across the cell membrane.
4. Mechanisms by which proteins and lipids are transported from their point of synthesis, sorted, and inserted into various organelles.
5. Signal transduction processes in bacteria, vertebrate, and invertebrate organisms, as well as molecular pathogenesis.

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.

E. Bayer
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Structural and functional aspects of the multi−enzyme cellulosome complex from cellulose−degrading bacteria.

1. The cohesin−dockerin couple − Protein−protein interactions that mediate recognition and specificity in cellulosome assembly.

2. Cellulose−binding domains as models for protein−sugar interactions.

3. Structure determination and comparative genomics of cellulosome components.

4. Nanosome technology − Selective engineering of chimaeric cellulosome constructs for nanotechnology.

5. Avidin−biotin system − Mutated avidins and streptavidins

E. Bibi

eitan.bibi@weizmann.ac.il

The signal recognition particle (SRP) system in *Escherichia coli*:
E. Bibi, Elena Bochkareva; Iris Yedidia; Anat A. Herskovits; Asa Eitan; Eyal Barak;

1. FtsY, the essential prokaryotic SRP−receptor: its role in biogenesis of membrane proteins.
2. Identification of cellular factors involved in targeting insertion and assembly of membrane proteins.
3. Membrane targeting of ribosomes in E. coli.
4. Regulation of expression of E. coli membrane proteins.

Structure/function studies of the *E. coli* multidrug transporter, MdfA.
E. Bibi, Julia Adler; Oded Lewinson; Shahar Molshanski−Mor

1. Studying the multidrug recognition pocket of MdfA by genetic and biochemical tools
2. 2D and 3D crystallization of MdfA
3. Studying the driving force of MdfA−mediated multidrug transport
4. Studying possible physiological activities of MdfA

R. Dikstein
rivka.dikstein@weizmann.ac.il

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

1. Functional analysis of tissue 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.

M. Eisenbach
michael.eisenbach@weizmann.ac.il

Chemotaxis of bacteria

1. Molecular mechanisms of sensing, signaling and response
2. Molecular mechanism of function of the switch of the bacterial flagellar motor

Chemotaxis of mammalian sperm cells

1. Kinematics of sperm chemotaxis

2. Molecular mechanism of sperm chemotaxis

Thermotaxis of mammalian sperm cells: molecular mechanism

Z. Elazar
zvulun.elazar@weizmann.ac.il

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
mike.fainzilber@weizmann.ac.il

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. Futerman
tony.futerman@weizmann.ac.il

Sphingolipid signaling during neuronal development.

The role of lipids in the regulation of neuronal growth.

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

H. Garty
haim.garty@weizmann.ac.il

Regulation of epithelial ion transport:

1. Structure−function relationships of epithelial Na+ channels.
2. Kinases mediating hormonal regulation of epithelial ion−transport.
3. FXYD proteins as tissue specific regulators of the Na+/K+ ATPase.

S. Karlish
steven.karlish@weizmann.ac.il

Molecular mechanisms involved in generation of essential hypertension.

Regulation of Na/K−ATPase by FXYD proteins.

Molecular structure and function of Na/K−ATPase.

Z. Livneh
zvi.livneh@weizmann.ac.il

Mechanisms and biomedical applications of DNA repair.

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

Molecular mechanisms involved in generation of essential hypertension.

D. Mirelman
david.mirelman@weizmann.ac.il

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. Mechanism of action of Allicin from Garlic and its potential applications for therapy.
4. Transcriptional gene silencing mechanisms

U. Pick
bcpick@weizmann.ac.il

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

Cold acclimation and cold−induced proteins in Dunaliella.

Iron uptake by an algal transferrin.

Structure and function of salt−resistant proteins.

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

Z. Reich
ziv.reich@weizmann.ac.il

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
e.reuveny@weizmann.ac.il

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
gideon.schreiber@weizmann.ac.il

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

yechiel.shai@weizmann.ac.il

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
y.shechter@weizmann.ac.il

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
meir.shinitzky@weizmann.ac.il

Tumor vaccines prepared by application of hydrostatic pressure.

Characterization of antigens implicated in mental disorders.

Physiological signaling by cyclic glycerophosphates and their analogues.

D. Tawfik
dan.tawfik@weizmann.ac.il

Evolution and mechanism of enzymes:

1. Molecular evolution in man−made cell−like compartments.

2. Directed evolution of tailor−made hydrolases (esterases, phosphoesterases and amidases) and DNA−modifying enzymes.

3. The role of promiscuity and conformational plasticity in protein evolution.

M. Walker
m.walker@weizmann.ac.il

Selective gene expression in pancreatic beta cells:

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
david.wallach@weizmann.ac.il

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.

4. Regulation of the activity of the NF kappa B transcription factors.

5. The caspases, their functions and mechanisms of activation.

Department of Molecular Genetics

Adi Kimchi, 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. Genetic approaches are being used in model organisms and mamalian cell cultures for studying developmental processes and basic cellular events such as apoptosis. The molecular basis of human genetic diseases is being explored and various mice model systems were generated for this purpose. Another focus of the department is on genomics and computational biology. Utilization of quantitative approaches is undertaken for the analysis of the wealth of information provided by the completed genome sequences and the accumulating gene expression data from DNA arrays.

N. Barkai
naama.barkai@weizmann.ac.il

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

Quantitative study and modeling of morphogen gradients in Drosophila.

J. Beckmann
j.beckmann@weizmann.ac.il

Positional cloning of inherited diseases.

Pharmacogenetics.

Modeling the impact of coding SNPs on protein's structures and functions.

A. Elson
ari.elson@weizmann.ac.il

Analysis of how physiological processes are regulated by protein dephosphorylation.

In particular, analysis of the role of protein tyrosine phosphatase Epsilon (PTP∝) in mouse physiology and tumorigenesis using molecular, cellular, and whole−animal (transgenic and knockout mice) approaches. Major topics studied include:

1. The role of PTP∝ in mammary tumorigenesis/breast cancer.
2. The role of PTP∝ in myelination of axons in the nervous system.
3. Identification of substrates and interactors of PTP∝.
4. Characterization of alternative isoforms of PTP∝.
5. Obtaining molecular−level insight into the details and consequences of protein dephosphorylation by PTP∝.

J. Gerst
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The Molecular Basis for Cellular Secretion: SNAREs, SNARE regulators, and Secretory Vesicles

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.
4. Role of mRNA localization in control of polarized growth in yeast.

Y. Groner

yoram.groner@weizmann.ac.il

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.

The Runx3 transcription factor and somatosensory−related ataxia

C. Kahana
chaim.kahana@weizmann.ac.il

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. Kimchi
adi.kimchi@weizmann.ac.il

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
doron.lancet@weizmann.ac.il

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.

S. Pietrokovski
shmuel.pietrokovski@weizmann.ac.il

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
orly.reiner@weizmann.ac.il

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).

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
michel.revel@weizmann.ac.il

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

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.
M. Revel, J. Chebath

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

M. Rubinstein
menachem.rubinstein@weizmann.ac.il

Physiology and pathology of Interleukin−18 binding protein (IL−18BP), regulation of IL−18BP gene expression, gene therapy with IL−18BP.
M. Rubinstein, D. Novick

Role of leptin in angiogenesis, tumor development and fertility.

L. Sachs
leo.sachs@weizmann.ac.il

Stem cell biology: Molecular control of normal hematopoietic and leukemic stem cells and apoptosis.
L. Sachs, J. Lotem

1. Cytokine and apoptosis gene networks in the development of normal and malignant hematopoietic stem cells.

2. Molecular pathways for apoptosis, differentiation and the suppression of malignancy.

3. Therapeutic applications of hematopoietic cytokines and stem cell biology.

B. Shilo
benny.shilo@weizmann.ac.il

Development of the *Drosophila* tracheal system.

Signaling by the Drosophila EGF receptor pathway during development.

R. Simantov
rabi.simantov@weizmann.ac.il

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
lgvolk@weizmann.ac.il

The molecular basis for muscle−tendon interactions during embryonic development

1. The mechanism by which the RNA−binding protein Held out wing regulate tissue differentiation in Drosophila.

2. The mechansim of muscle attraction by tendon cells.

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

4. The involvement of Quaking in Schwann cell maturation.

Department of Plant Sciences

Gad Galili, 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
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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
marvin.edelman@weizmann.ac.il

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.

National Center for Bioinformatic−Genetic Infrastructure.

R. Fluhr
robert.fluhr@weizmann.ac.il

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.

National Center for Plant Genome Research.
R. Fluhr, O. Davydov

Map−based cloning technologies and application of microarray technology to problems in plant growth and environmental response.
R. Fluhr, O. Davydov

G. Galili
gad.galili@weizmann.ac.il

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
gideon.grafi@weizmann.ac.il

How Do Differentiated Plant Cells Acquire Competence for Fate Switch?

1. We study this issue from the perspective of chromatin structure focusing on:
2. DNA methylation and methyl−CpG−binding proteins
3. Histone modifications
4. Applying DNA chip technology and other methods to identify genes that are upregulated or downregulated during acquisition of competence for cell fate switch

J. Gressel
jonathan.gressel@weizmann.ac.il

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.

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

A. Levy
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Functional genomics in tomato: linking between genes and functions through mutants analysis.

Genetic changes during wheat domestication
A. Levy, M. Feldman, S. Weiner

The impact of polyploidy on genome structure and expression
A. Levy, M. Feldman

DNA recombination and repair in plants:

1. DNA mismatch repair and recombination between divergent sequences

2. Chromatin remodelling and homologous recombination

A. Scherz
avigdor.scherz@weizmann.ac.il

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.

Faculty of Biology

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

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

Endothelin1−mediated regulation of vascularization: role in implantation.

Molecular characterization of the ovulatory cascade

A. Gross
atan.gross@weizmann.ac.il

Mitochondria in apoptosis: mitochondria−dependent and independent functions of the BCL−2 family member BID.

The connection between reactive oxygen species and apoptosis: Use of yeast as a model system to explore the function of the BCL−2 family member BAX.

Ovarian follicle atresia as a model of apoptosis: The role of the core apoptotic machinery in this process.

F. Kohen
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Ovarian follicle atresia as a model of apoptosis: The role of the core apoptotic machinery in this process.

Peptides isolated from phage displayed peptide libraries as estrogen mimetics.
F. Kohen, E. Katzir

Anti−idiotypic antibodies as probes of molecular mimicry.

M. Liscovitch
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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.

M. Neeman
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Hormonal regulation of angiogenesis and adhesion in ovarian carcinoma, dormancy and angiogenesis in ovarian tumors
M. Neeman, Assaf Gilead, Gila Meir

In vivo MRI analysis of angiogenesis, vascular regression, vascular maturation and lymphatic drain.
M. Neeman, Hagit Dafni, Keren Ziv, Dorit Granot, Liora Shiftan, Gila Meir, Batya Cohen, Galit Mazooz Roman Gersner

Positive and negative regulators of pre−ovulatory angiogenesis in the normal rat ovary, ovarian preservation by ectopic implantation.
M. Neeman, Tomer Israely, Alex Tsafriri

Y. Salomon
yoram.salomon@weizmann.ac.il

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
rony.seger@weizmann.ac.il

Signal transduction via G protein−coupled receptors.

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

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

A. Tsafriri
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Molecular regulation of oocyte maturation in mammals.

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.

Y. Yarden
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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

Zelig Eshhar, 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
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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
ruth.arnon@weizmann.ac.il

Studies on antigenicity and vaccine development.

Immunochemical aspects of schistosomiasis.

Synthetic peptides and synthetic vaccines.
R. Arnon, M. Sela

Experimental allergic encephalomyelitis and its suppression by basic copolymers of amino acids: Relevance to multiple sclerosis.
R. Arnon, M. Sela

The possible use of antibodies for local drug delivery of the anti−cancer agent, cis−platinum.
R. Arnon, M. Wilchek

A. Ben−Nun
avraham.ben−nun@weizmann.ac.il

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
gideon.berke@weizmann.ac.il

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. Cohen
irun.cohen@weizmann.ac.il

Autoimmune T cells and tissue maintenance in the nervous system
I. Cohen, M. Schwartz

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

Regulation of immune inflammation by small carbohydrate molecules
I. Cohen, O. Lider

Autoimmunity to p53 and the development of systemic lupus erythematosus
I. Cohen, V. Rotter

Autoimmune diabetes: Pathogenesis and immune therapy.

L. Eisenbach
lea.eisenbach@weizmann.ac.il

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

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

Antigen presentation and induction of anti−tumor immunity.

Z. Eshhar
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Modulation of IgE−receptor interactions in the allergic response.

Design and generation of catalytic antibodies.

Immuno−gene therapy of tumors.

S. Jung
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The Contribution of Blood Monocytes to Peripheral Myeloid Cell Compartments under Homeostasis and Pathogen Challenge

Definition of Dendritic Cell In Vivo Functions Using Conditional Cell Ablation

T. Lapidot
tsvee.lapidot@weizmann.ac.il

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

1. The role that chemokines, cytokines, proteolytic enzymes adhesion molecules and stromal cells play in human blood forming stem cell migration, homing and repopulation in vivo.

2. The roles of proteolytic enzymes and chemokines in stress induced mobilization of stem cells from the bone marrow into the circulation.

3. Steady state homeostatic release and function of blood circulating stem cells.

4. In vivo migration and dissemination of human leukemic cells, the role of proteolytic enzymes and chemokines.

5. Hematopoietic stem cells / blood vessel wall interactions during transendothelial migration, assayed by electron microscopy.

6. CXCR4/SDF−1 signaling in normal and leukemic hematopoiesis.

7. Lentiviral vectors for stem cell gene transfer. GFP and CXCR4 overexpression

8. The essential roles of the adhesion molecule CD44 in normal and malignant stem cell motilitiy as assayed by confocal microscopy.

2. Differentiation of T lymphocytes from human hemopoietic stem cells in an in vivo experimental model.

O. Lider
ofer.lider@weizmann.ac.il

Chemical and functional analysis of natural inhibitors of inflammation.
O. Lider, Cohen, I. R., Schwartz, M.

1. Disaccharide products of heparan sulfate

2. Products of IL−2

3. Enzymatically−generated products of chondroitin sulfate

4. Small peptides found in fluids of human chronic wound

Analysis of the pro− or anti−inflammatory effects of novel inflammatory mediators
O. Lider, Cohen, I. R.

1. Heat shock proteins
2. Fas ligand
3. Acute phase proteins
4. Heparanase

Analysis of cell surface adhesion receptor function

1. Integrins
2. Chemokine receptors
3. Cytokine receptors
4. Fas receptor

Evaluation of the enzymatic machinery required for leukolytes function and migration
O. Lider, Vlodavsky, I., Sagi, I., Alon, R., Cohen, I. R., Schwartz, M.

1. Elastase
2. MMP
3. heparanase
4. chondroitinase

Analysis of the effects of cytokines and chemokines on lymphocyte function in inflammation

1. T cell activation
2. T cell interactions with tissue components
3. T cell interactions with extracellular matrix (ECM)
4. Apoptosis in the context of ECM

E. Mozes
edna.mozes@weizmann.ac.il

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.

Autoimmunity in aging: The SLE experimental model.

I. Pecht
israel.pecht@weizmann.ac.il

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
yair.reisner@weizmann.ac.il

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.

M. Sela
michael.sela@weizmann.ac.il

Down regulation of the clinical manifestations of experimental autoimmune myasthenia gravis by a dual altered peptide ligand.
M. Sela, E. Mozes

Mechanism of action of copolymer 1, a drug against expeallergic encephalomyelitis and multiple sclerosis.
M. Sela, R. Arnon

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

I. Shachar
idit.shachar@weizmann.ac.il

Determine the mechanisms regulating immature B cell differentiation in the spleen.

Follow the mechanisms controlling homing of immature B cells to the spleen.

Department of Molecular Cell Biology

Varda Rotter, 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 drive cells towards differentiation or apoptosis. These studies, focusing on the mechanisms stimulate cell 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−promoting signals triggered by adhesive interactions. Of special interest are proteins such as ″−catenin, which play a crucial role in reinforcing cell−cell adhesions as well as triggering gene expression.

U. Alon
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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
abraham.amsterdam@weizmann.ac.il

Plasticity of gene expression during differenatiation in the gonads.

Crosstalk amond signals that control apoptosis.

Carcinogenesis in endocrine glands.

A. Ben−Ze'ev
avri.ben−zeev@weizmann.ac.il

The interplay between ″−catenin signaling and p53−responsive pathways in the development of colon cancer.

The dual role of ″−catenin and plakoglobin in adhesion and transactivation: novel target genes activated by ″−catenin and their role in oncogenesis.

The molecular basis of the role of cell−cell adhesion in malignant transformation: the ″−catenin/APC case.

A. Bershadsky
alexander.bershadsky@weizmann.ac.il

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
eli.canaani@weizmann.ac.il

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
benny.geiger@weizmann.ac.il

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

doron.ginsberg@weizmann.ac.il

Regulation of the activity of the E2Fs transcription factors.

E2F induced apoptosis and its modulation by Ras.

Repression of mitotic genes by E2F/RB complexes as part of the G2/M checkpoint.

E2F−dependent regulation of DNA repair genes.

Z. Kam
zvi.kam@weizmann.ac.il

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
uri.nudel@weizmann.ac.il

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

M. Oren
moshe.oren@weizmann.ac.il

Relationship of p53 to programmed cell death.

Regulation of the Mdm2 oncoprotein.

Role of p53 in senescence.

Structure−function analysis of p53.

Molecular biology of p63.

Regulation of proteins by phosphorylation, nitrosylation and acetylation.

E. Peles
peles@weizmann.ac.il

Cellular junctions of myelinated nerves.

Role of Caspr family members in neuronal development.

Generation of specialized domains along myelinated axons.

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

Molecular mechanisms of neuron−glia interactions.

V. Rotter
varda.rotter@weizmann.ac.il

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
yehiel.zick@weizmann.ac.il

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

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

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

D. Zipori
dov.zipori@weizmann.ac.il

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

1. Mesenchymal stem cells: patterns of gene expression and biological functions.
2. Characterization of the cytokine antagonist, Activin A; signal transduction and biological functions.
3. Stem cell growth and the organ stroma.
4. PSF, a pre mRNA splicing factor involved in processes of differentiation in stem cell systems.

Department of Neurobiology

Zvi Vogel, Head

Research in Neuroscience in the Department of Neurobiology encompasses a wide variety of subjects, in areas including cellular and molecular biology, neuroanatomy, functional magnetic resonance imaging (fMRI), physiology, pharmacology, psychophysics, and computational sciences.

Basically, the research of the various groups of the Department covers, among others, the following topics:

- Analysis of the molecular and cellular basis of neuronal and synaptic function.
- Imaging of neuronal activity underlying higher brain functions.
- Tracing and characterization of neuronal communication profiles.
- Characterization of the CNS response to trauma and lesion; developing molecular and cellular therapeutic agents.
- Determination of the underlying processes and mechanisms of vision, perception, learning, and memory in behaving rodents and primates.
- Computer modeling of brain function.

At the Neurobiology Department, the structure, function, development, and plasticity of the nervous system are studied at various levels of analysis, using different types of cell and experimental animal models. The groups studying neuronal function at the molecular and cellular levels use *in vitro* systems ranging from non−neuronal and neuronal cell lines to primary neuronal and glial cells of cerebellar, hippocampal and cortical origin. In many cases, the cells studied are transfected with genes of interest. These cell systems allow the study of the roles of various components of the nervous system, including cell surface membrane components, specific enzymes, neurotransmitters, neuromodulators, growth factors, neuroreceptors, lipid components, ionic channels and cytoskeletal constituents. Algorithms for the synaptic plasticity between neurons, and the role of dendritic ion channels in synaptic input and information processing, are also being studied. Injury models of nerve lesion and oxidative stress paradigms are applied to examine the principles of CNS regeneration, rescue from ischemia and stroke, and apoptotic cell death and senescence.

The groups studying the CNS at the system level are striving to understand the complex neuronal mechanisms underlying learning, memory, and sensory processing (vision, taste, smell), and to determine the relationship between brain and mind. Using track tracing methods, the rules governing the interconnections in

the visual cortex are being unraveled. Behavioral studies focus on principles of learning and consolidation, cortical information processing, learning disabilities, and addiction. Functional brain imaging of the human visual cortex is being studied by various techniques, including fMRI. Psychophysical approaches are being used to define processes involved in image segmentation, learning and memory skill acquisition, motor control, and language. Nearly 20 groups of researchers carry out both independent studies and collaborative research with colleagues from within the Department and outside it.

E. Ahissar
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Active sensing: Principles of sensory processing within the sensory−motor loop.

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

2. Modifications of vibrissal processing by learning: Neuronal plasticity, role of acetylcholine, theory.

3. Encoding, sensory−motor control, and learning in humans: Touch and vision.

Y. Dudai
yadin.dudai@weizmann.ac.il

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
irith.ginzburg@weizmann.ac.il

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

Neuronal polarity: Control of expression of microtubule genes.

A. Grinvald
amiram.grinvald@weizmann.ac.il

The functional architecture underlying visual perception.
A. Grinvald, H. Slovin, M. Tsodyks, E. Ahissar, A. Arieli

Cortical dynamics underlying higher brain functions in behaving monkeys.
A. Grinvald, H. Slovin, M. Tsodyks, E. Ahissar, A. Arieli

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

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

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

The mechanisms responsible for neuroimaging based on the cortical microcirculation.
A. Grinvald, H. Slovin, M. Tsodyks, E. Ahissar, A. Arieli

Y. Koch
y.koch@weizmann.ac.il

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.

I. Lampl
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Construction of receptive field properties in the primary visual cortex

Synaptic plasticity in the visual cortex

Noise and synchrony in the mammalian cortex

S. Lev
sima.lev@weizmann.ac.il

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
rafael.malach@weizmann.ac.il

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.

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

M. Schwartz
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The cross−talk between the immune and nervous systems autoimmunity as a mechanism of tissue repair: Molecular, cellular, physiological and behavioral aspects.

Immunological aspects of neuronal loss in neurodegenerative and mental disorders (Alzheimer s, ALS, Huntingdon, Glaucoma).

Spinal cord injury and repair

Development of vaccination for neurodegenerative disorders.

Neurogenesis (stem cells) and inflammation in the CNS.

M. Segal
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Physiology and behavior in transgenic mice.

Neuromodulation in the brain.

Intracellular calcium in neurons.

I. Silman
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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. Teichberg
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Enzymatic scavenging of blood glutamate in the treatment of neurodegenerative diseases
V. Teichberg, I. Maoz, G. Kleinman, Y. Wang

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

2. Glutamate and glucose transport in an in vitro model of the blood brain barrier

Protein−protein interactions of glutamate receptors at the synaptic membrane.
V. Teichberg, J. Ratnam

Interactions of glutamate receptors and anti−Glutamate receptor antibodies in epilepsy.
V. Teichberg, Y. Ganor, K. Cohen−Kashi

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

Information transmission through dynamic synapses.

Population activity in visual cortex.

Z. Vogel
zvi.vogel@weizmann.ac.il

Regulation of signaling and changes in gene expression by chronic cannabinoid or opiate exposure.

The cannabinoid ligands, their endogenous ligands and signal transduction.

Molecular mechanisms of opiate addiction, tolerance and withdrawal.

E. Yavin
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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.

Faculty of Chemistry

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.

I. Averbukh
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Atomic and molecular wave packets, ultra−fast optical phenomena.

Laser control of molecular orientation.

Manipulation of atoms and molecules by laser fields, atom lithography.

A. Burshtein
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Theory of transfer reactions in solutions
A. Burshtein, V. Gladkikh

1. Remote electron transfer in radical ion pairs
2. Spin forbiden recombination of radical ions and exciplexes
3. Concentration dependence of contact reactions in non−binary theories
4. Viscosity and magnetic field effects in transfer reactions in solutions

Hopping and diffusional reactions of solvated electron

L. Frydman
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Development of new methods in nuclear magnetic resonance and magnetic resonance imaging analysis.

Application of novel magnetic resonance methods to the study of new materials, bioinorganic metal−binding processes, liquid crystalline phases.

D. Goldfarb
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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.

G. Haran
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Single−molecule Raman spectroscopy as a probe of surface dynamics

Protein conformational and association dynamics studied with single−molecule fluorescence spectroscopy.

Protein folding studied on the level of the individual molecule.

G. Kurizki
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Quantum optics of cold atoms .

Superluminal effects in optics.

Quantum and nonlinear optics in photonic band gap structures.

Control of quantum states and decoherence.

R. Naaman
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Penetration of electrons through chiral molecular monolayers
R. Naaman, Zeev Vager, Dep. of Particle Physics

Electron transmission through organized organic thin films.

Molecular controlled semiconductor electronic devices.

Molecular electronics
R. Naaman, David Cahen, Mordechai Sheves

Electronic and magnetic properties of organized organic thin films
R. Naaman, Zeev Vager, Dep. of Particle Physics

E. Pollak
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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.

Y. Prior
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Alignment and orientation of atoms and molecules in strong laser fields.

Strong field nonlinear optics.

Preparation and probing of excited molecules by ultrashort shaped femtosecond pulses.

femtosecond laser material processing

I. Procaccia
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Turbulence.

Fractals and scaling in nonequilibrium physics.

Complex growth problems.

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

Quantum information and computing.

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

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

D. Tannor
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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.

S. Vega
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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.

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 34, 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.

E. Aharonov

Granular media, applications to landslides and Earthquakes.

1. Granular dynamic simualtions (with Dr. Dave Sparks)

2. Liquifaction experiments (with Dr Amotz Agnon, Sofia Schnitke)

Fluid flow in deformable and reactive porous media.

Modeling of rock failure
E. Aharonov, Dr Regina Katsman, Dr. Harvey Scher

Experimental Pressure Solution
E. Aharonov, Dr Chris Scholz, Zvi Karz

B. Berkowitz
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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.

J. Karni
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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.

Y. Rudich
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Chemical identification of organic compounds in atmospheric aerosols.

1. Absorption of organic compounds to mineral dust particles

2. Identification of water−soluble material in biomass burning aerosols from Brazil

3. Use of analytical techniques such as GCMS and ion chromatography

Aerosol−Cloud interactions
Y. Rudich, Prof. Rosenfeld − Hebrew University, Prof. Levin − Tel Aviv University

1. Desert dust and its effects of precipitation
2. The effect of salt−dust on precipitating clouds
3. Effect of the Kuwait oil fires (1991) on clouds

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

1. Flowtube experiments
2. Aerosol flow experiments
3. Reactions of ozone and OH with particles, identification of surface and bulk products

Nano−sized particles and their environmental effects

1. Engeeniring of multicomponent submicron sized particles
2. Studying the chemical processes of submicron particles
3. Activation of particles to cloud droplets
4. Electron microscopy of micron sized particles

A. Shemesh
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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
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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.

El−Niñ's dynamics and chaos.

D. Yakir
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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.

Department of Materials and Interfaces

Reshef Tenne, 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); nanomaterials, like carbon nanotubes, and inorganic nanotubes; ultra thin ferroelectric films; 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 nanocomposites 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. Three new research groups have been established: Dr. Ernesto Joselvich−carbon nanotubes and scanning probe microscopy; Dr. Roy Bar−Ziv−studies the mechanisms of biological transcription on silicon chip using microfabriction and microfluidics. Dr. Leeor Kronik− uses density functional theory to study clusters; nanocrystalline material and optical phenomena in semiconductors.
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 force measurements techniques at Ångstrom surface separation; nanomechanical testing techniques; electrochemistry; grazing angle X−ray diffraction and X−ray reflectivity using bright and collimated light from synchrotron sources; second harmonic generation; optical tweezers; scanning probe microscopy and spectroscopy, grazing angle infrared spectroscopy; and unique applications of X−ray photoelectron spectroscopy. Two new research facilities, which are used extensively by the department scientists, have been completed this year, i.e the high resolution electron microscopy laboratory, and the combined clean rooms/microfabrication/biological specimen manipulation laboratory.

D. Cahen

Molecule − controlled electronics and optoelectronics
D. Cahen, collaborations with M. Sheves, R. Naaman, A. Shanzer, C. Sukenik (Bar Ilan), F. Diederich (ETHZ)

1. Contacts between molecules electronic materials
2. Unique molecular effects at solid interfaces, NDR and more
3. Preparation, characterization and device use of molecules at Interfaces
4. Metal−Molecular Monolayer−Semiconductor Junctions

Electron transport across molecules and molecular layers.

D. Cahen, collaboration with M.Sheves

1. How can electrons pass through molecules and molecular layers?

2. How can information pass across supposedly

Poly− and nano−crystalline solar cells, their chemistry and physics.
D. Cahen, collaborations with G. Hodes, S. Cohen, K. Gartsman,A. Zaban (Bar Ilan U)

1. Solid State Surface Chemistry of Photovoltaic Materials Interfaces

2. How and why do nanocrystalline solar cells work?

3. Molecular surface control over polycrystalline solar cells.

M. Elbaum
michael.elbaum@weizmann.ac.il

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.

G. Hodes
gary.hodes@weizmann.ac.il

Electrochemical and chemical deposition of nanocrystalline semiconductor quantum dot (QD) films.

Surface modification of semiconductor nanocrystals.

Charge transfer in QDs.

Thin film photovoltaic cells.

J. Klein
jacob.klein@weizmann.ac.il

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.

L. Kronik

Spintronic materials: electronic and magnetic properties

Organic semiconductors: structural and electronic properties
L. Kronik, E. Umbach, C. Heske (U. Wurzburg, Germany)

Quantum dots: optical properties

Site−specific photoelectron spectroscopy: predicting explaining experiment
L. Kronik, J. C. Woicik (NIST, USA)

Nano−clusters: non−equilibrium effects

M. Lahav
meir.lahav@weizmann.ac.il

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;
M. Lahav, L. Leiserowitz, 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.
M. Lahav, L. Leiserowitz, 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 d
M. Lahav, L. Leiserowitz, I.Weissbuch

Stereochemical studies on crystal nucleation of Cholesterol in 2−and 3−D at the water interface.
M. Lahav, L. Leiserowitz

I. Lubomirsky
igor.lubomirsky@weizmann.ac.il

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.

S. Reich
shimon.reich@weizmann.ac.il

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.

I. Rubinstein
israel.rubinstein@weizmann.ac.il

Novel nanomaterials prepared by template synthesis in nanoporous alumina membranes.
I. Rubinstein, A. Vaskevich

Nanostructures based on surface−modified nanoparticles.
I. Rubinstein, A. Vaskevich

Chemical and biological sensing using transmission surface plasmon resonance (T−SPR) spectroscopy.
I. Rubinstein, A. Vaskevich

Coordination self−assembly of nanostructures comprising organic / inorganic building blocks.
I. Rubinstein, A. Vaskevich

Self−assembled supramolecular systems on metal substrates.
I. Rubinstein, A. Shanzer, A. Vaskevich

S. Safran
sam.safran@weizmann.ac.il

Statistical physics of soft matter:

1. Membrane self−assembly of surfactants, lipids, and amphiphilic polymers.
2. Coupling of shape and shear elasticity in membranes and in biological cells.
3. Microemulsions: structure, phase behavior, dynamics.
4. Membranes: tension induced fusion, inclusions in membranes.
5. Fluctuation induced interactions in charged colloidal and membrane systems.

J. Sagiv
jacob.sagiv@weizmann.ac.il

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
J. Sagiv, R. Maoz

Self−replicating multilayers.
J. Sagiv, 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.
J. Sagiv, R. Maoz, S. Cohen

R. Tenne
reshef.tenne@weizmann.ac.il

Inorganic nanotubes and inorganic fullerene−like materials: new materials with cage structure.

D. Wagner
daniel.wagner@weizmann.ac.il

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.
D. Wagner, S. Weiner, L. Addadi

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. Bachi
mario.bachi@weizmann.ac.il

Organic synthesis through free radical reactions.

Synthesis of Yingzhaosu A and related antimalarial drug candidates.

Stereocontrol through Sulfur−Mediated Temporary Intramolecularization of Reactions.

Y. Burstein
yigal.burstein@weizmann.ac.il

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

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.

M. Fridkin
mati.fridkin@weizmann.ac.il

Studies include: drug design, pro−drugs, long−acting drugs and drug delivery.
M. Fridkin, Y. Shechter

Chemical−Biological and Clinical studies on novel drugs, primarily of peptidic nature,related to therapy of infectious ,inflamatory and neoplastic diseases.
M. Fridkin, Y. Koch I. Gozes (TAU) I. Offek (TAU) R. Catane (TEL−HASHOMER)

Novel synthetic and analytical methdologies are being developed.

1. Solid−phase synthesis
2. Classical solution chemistry
3. Combinatorial technologies

G. 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
david.milstein@weizmann.ac.il

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.

4. Generation and stabilization of elusive (potentially biologically active) molecules

A. Minsky
avi.minsky@weizmann.ac.il

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
ronny.neumann@weizmann.ac.il

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
abraham.shanzer@weizmann.ac.il

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.

M. Sheves
mudi.sheves@weizmann.ac.il

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
cosper1@weizmann.ac.il

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.

Department of Structural Biology

Amnon Horovitz, Head

Structural biology is an increasingly important and exciting area. At the Weizmann Institute, much of the research in this area is carried out in the Faculty of Chemistry. Current research projects involve utilization of the main methodologies available for biological structural studies, such as X−ray crystallography, NMR, electron microscopy, molecular biology and various other spectroscopic techniques. Modern and sophisticated instrumentational facilities are available, most of which are state−of−the−art. Studies are being performed to determine molecular structures and structure−function relationships in biological macromolecules, such as proteins, DNA chains and their complexes. 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 determine their activity. Antigen−antibody complexes and other protein−protein interactions such as that of interferon with its receptor are being studied by multi−dimensional NMR methods. Biomineralization, i.e. 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.

L. Addadi
lia.addadi@weizmann.ac.il

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.

Mechanism of cell adhesion using crystal substrates.
L. Addadi, B. Geiger

J. Anglister
jacob.anglister@weizmann.ac.il

The structure of the V3 loop ohf HIV−1 enevelope protein gp120
J. Anglister, S. Zolla−Pazner

NMR structure of alpha Interferon complex with its receptor
J. Anglister, G. Schreiber

NMR structure of the alpha subunit of the acetylcholine receptor
J. Anglister, ZZ. Wang

The structure of the transmembrane glycoprotein of HIV−1 gp41.
J. Anglister, Y. Shai

D. Fass
deborah.fass@weizmann.ac.il

Structures of retrovirus envelope proteins and mechanisms of retrovirus entry into cells.

Structure and function of proteins that modulate intracellular membrane dynamics.

Origins of disulfide bonds for oxidative protein folding.

A. Horovitz
amnon.horovitz@weizmann.ac.il

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

LFER analysis of allosteric transitions in proteins.

Chaperonin−mediated protein folding.

K. Muszkat

alex.muszkat@weizmann.ac.il

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
mark.safro@weizmann.ac.il

Crystal structure of cytoskeletal proteins: vinculin, E−cadherin.
M. Safro, B. Geiger

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

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

I. Sagi
irit.sagi@weizmann.ac.il

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

Z. Shakked
zippi.shakked@weizmann.ac.il

Crystal structure and solution studies of DNA oligomers.
Z. Shakked, Donald Crothers (Yale University)

1. DNA regulatory elements

2. DNA bending by adenine−thymine tracts

Structural and biochemical studies of proteins involved in transcriptional regulation.

1. The tumor−suppressor protein p53 and its interaction with DNA and the basal transcription machinery

2. The leukemia−related RUNX1(AML1) transcription regulator

J. Sussman
joel.sussman@weizmann.ac.il

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 ACh

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.

S. Weiner
steve.weiner@weizmann.ac.il

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

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

Biomineralization: mechanisms of mineral formation and growth in biology.
S. Weiner, L. Sddadi

A. Yonath
ada.yonath@weizmann.ac.il

Ribosomes: structure analysis by X−ray crystallography.

Antibiotics of protein biosynthesis.

Molecular Genetics and biochemistry of ribosomal RNA and proteins.

Faculty of Mathematics and Computer Science

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.

R. Basri
ronen.basri@weizmann.ac.il

Developing new methods for object recognition and classification.

Designing algorithms for perceptual grouping and segmentation.

Applying methods from computer vision to visual robot navigation.

A. Brandt
achi.brandt@weizmann.ac.il

Multi−level computational methods, scientific computation.

U. Feige
uriel.feige@weizmann.ac.il

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

T. Flash
tamar.flash@weizmann.ac.il

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

O. Goldreich
oded.goldreich@weizmann.ac.il

Probabilistic proof systems, Pseudorandomness, Foundations of Cryptography, Complexity theory.

S. Goldwasser
shafrira.goldwasser@weizmann.ac.il

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

D. Harel
david.harel@weizmann.ac.il

Visual formalisms, software engineering, biological modeling, graph drawing and visualization, odor communication and synthesis

M. Irani
michal.irani@weizmann.ac.il

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

D. Michelson
daniel.michelson@weizmann.ac.il

Numerical analysis, differential equations, dynamical systems.

M. Naor
moni.naor@weizmann.ac.il

Cryptography and Complexity

Distributed Computing

Concrete Complexity

D. Peleg
david.peleg@weizmann.ac.il

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

A. Pnueli
amir.pnueli@weizmann.ac.il

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.

R. Raz
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circuit complexity, communication complexity, propositional proof theory, probabilistic checkable proofs, lower−bounds, quantum computation, derandomization.

V. Rom−Kedar
vered.rom−kedar@weizmann.ac.il

Transport and mixing in fluid flows.

Structure of highly chaotic systems (smooth billiard potentials).

Structure of near−integrable Hamiltonian systems.

A. Shamir
adi.shamir@weizmann.ac.il

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

E. Shapiro
ehud.shapiro@weizmann.ac.il

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

S. Ullman
shimon.ullman@weizmann.ac.il

Vision, image understanding, brain theory, artificial intelligence.

Department of Mathematics

Gideon Schechtman, Head

The principal research interests of the department lie in the two general areas of mathematical analysis and its 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.

Z. Artstein
zvi.artstein@weizmann.ac.il

Dynamical systems, ordinary differential equations.

1. Singular perturbations
2. Relaxation, probability measure−valued solutions
3. Ergodicity

Control and optimal control.

1. Singular perturbations
2. Hybrid systems
3. Stabilization
4. Relaxation

Decisions under uncertainty

I. Benjamini
itai.benjamini@weizmann.ac.il

Probability and geometry.
I. Benjamini, A. Dvoretzky, G. Schechtman, O. Schramm

V. Berkovich
vladimir.berkovich@weizmann.ac.il

p−adic analytic geometry.

Number theory.
V. Berkovich, S. Gelbart

Algebraic geometry.
V. Berkovich, S. Yakovenko

A. Dvoretzky

aryeh.dvoretzky@weizmann.ac.il

Banach spaces.
A. Dvoretzky, G. Schechtman

H. Dym
harry.dym@weizmann.ac.il

Inverse problems.

Operator theory.
H. Dym, V. Katsnelson, M. Solomyak

Classical analysis.
H. Dym, V. Katsnelson, Y. Yomdin

S. Gelbart
stephen.gelbart@weizmann.ac.il

Automorphic forms and L−functions.

Group representations.
S. Gelbart, A. Joseph, A. Regev

M. Gorelik
maria.gorelik@weizmann.ac.il

Representation theory and Lie superalgebras
M. Gorelik, V. Serganova

A. Joseph
anthony.joseph@weizmann.ac.il

Lie algebras and enveloping algebras, quantum groups.

Y. Kannai
yakar.kannai@weizmann.ac.il

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

Partial differential equations.
Y. Kannai, M. Solomyak

V. Katsnelson
victor.katsnelson@weizmann.ac.il

Harmonic analysis.

Complexity of functions and approximations.
V. Katsnelson, S. Yakovenko, Y. Yomdin

A. Regev
amitai.regev@weizmann.ac.il

Non−commutative ring theory.

S. Yakovenko
sergei.yakovenko@weizmann.ac.il

Singularity theory.

Limit cycles of vector fields, analytic theory of ordinary differential equations.
S. Yakovenko, Y. Yomdin

Y. Yomdin
yosef.yomdin@weizmann.ac.il

Analytic Theory of Differential Equations, Generalized Moments, Compositions
Y. Yomdin, M. Briskin, N. Roytvarf, F. Pakovich,

Zeroez distribution in Families of Analytic Functions
Y. Yomdin, M. Briskin, N. Roytvarf

Semialgebraic Complexity of functions
Y. Yomdin, G. Comte

High Order Data Representation, Nonlinear Approximation, based on Normal Forms of Singularities. Numerical methods

Faculty of Physics

Department of Condensed Matter Physics

Israel Bar−Joseph, 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.

T. Alexander
tal.alexander@weizmann.ac.il

Stars very near massive black holes.

The Galactic Center.

Gravitational Lensing.

Active Galactic Nuclei.

I. Bar−Joseph
israel.bar−joseph@weizmann.ac.il

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
alexander.finkelstein@weizmann.ac.il

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
y.gefen@weizmann.ac.il

Quantum dots: Electron electron interaction and dissipation.

The quantum Hall effect.

Interference and tunneling in quantum mechanics.

Dynamical effects, dissipation and thermodynamics in small quantum systems.
Y. Gefen, Y. Imry

M. Heiblum
moty.heiblum@weizmann.ac.il

Fractional charges in mesoscopic structures
M. Heiblum, Yunchul Chung, Oern Zarchin, D. Mahalu, V. Umansky

1. Charge and statistics of quasiparticles
2. Bunching of quasiparticles
3. Dilute quasiparticles and their behavior
4. High frequency shot noise measurements

III−V semiconductors their MBE growth
M. Heiblum, H. Shtrikman, V. Umansky

1. High speed devices
2. High purity semiconductors

Iinterference and dephasing of electrons
M. Heiblum, M. Avinun, I. Neder, D. Rohrlich, D. Mahalu, H. Shtrikman

1. Phase measurements via a double path interferometer
2. Controlled dephasing via 'which path' detector
3. Interferometers functioning in a high magnetic field

Y. Imry
yoseph.imry@weizmann.ac.il

Effects of interaction on localization and on single−electron resonances. Many−electron effects and phase−shifts. Dephasing of Quantum interference in mesoscopics. Quantum noise and its detection. The effects of quantum fluctuations on superconductivity i

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

S. Levit
shimon.levit@weizmann.ac.il

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
moti.milgrom@weizmann.ac.il

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

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

Y. Oreg
yuval.oreg@weizmann.ac.il

The transmission phase shift through a quantum dot that is coupled to leads and forms a many body state (known as the Kondo resonance) is calculated. This work is related to experimental studies at the Braun Center for Submicron Research at the Weizmann I

A generalization of Hund s rules to disordered dots.

Several aspects of disorder superconductors and normal metal − superconducting junctions are studied, including the interplay between bosons and fermions in this system.

Luttinger liquids in one−dimensional systems.

Bi−layer systems.

D. Shahar
dan.shahar@weizmann.ac.il

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
adiel.stern@weizmann.ac.il

Quantum Hall effect and composite fermion theory. Electronic transport in strong magnetic fields. Non−abelian quantum Hall states.

Low density two dimensional electronic systems.

Double layer electronic systems.

V. Usov
vladimir.usov@weizmann.ac.il

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

Physical processes in relativistic electron−positron plasma.

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

Physical processes in very strong magnetic fields.

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

E. Waxman
eli.waxman@weizmann.ac.il

Non−thermal processes in the inter−galactic medium

Gamma−ray bursts: Origin and underlying physics

Ultra−high energy cosmic−rays

High energy neutrino astrononmy

A. Yacoby

amir.yacoby@weizmann.ac.il

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
eli.zeldov@weizmann.ac.il

MgB_2 and $NbSe_2$ superconductors.

Magneto−optical imaging.
E. Zeldov, a.b

Vortex dynamics.

High−temperature superconductors.

Vortex matter phase transitions.

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.

O. Aharony
ofer.aharony@weizmann.ac.il

Relations between field theories and string theories.

Non−perturbative effects and formulations of string theories.

Supersymmetric gauge theories.

Non−gravitational string theories.
O. Aharony, M. Berkooz, E. Silverstein

A. Breskin
amos.breskin@weizmann.ac.il

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

A. Breskin, R. Chechik

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

Digital mammography, early detection of cancer, radiation damage to DNA.
A. Breskin, R. Chechik

Y. Frishman
yitzhak.frishman@weizmann.ac.il

From current to constituent quarks.
Y. Frishman, Marek Karliner

Non−abelian gauge theories.
Y. Frishman, Marek Karliner, Jacob Sonnenschein

Confinement and screening.
Y. Frishman, Jacob Sonnenschein

D. Gepner
doron.gepner@weizmann.ac.il

Rational conformal field theory and solvable lattice models.

S. Gurvitz
shmuel.gurvitz@weizmann.ac.il

Multi−dimensional tunnelling.
S. Gurvitz, W. Nazarewicz, K. Kato

1. Two−potential approach to tunneling problems
2. Cluster decay
3. Complex scaling and the semi−classical approximation
4. Modified tunneling Hamiltonian

Final state interaction in inclusive reactions.
S. Gurvitz, M. Traini

1. Bjorken scaling and confinement
2. Higher twist corrections to nucleon structure functions

Quantum transport in mesoscopic systems and the measurement problem.
S. Gurvitz, G. Berman, D. Mozyrsky

1. Quantum rate equations for coherent transport
2. Relaxation and dephasing in a qubit measurement
3. Single−spin measurement and decoherence
4. Zeno effect and quantum description of classical apparatus

M. Hass
michael.hass@weizmann.ac.il

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
uri.karshon@weizmann.ac.il

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. Kirson
michael.kirson@weizmann.ac.il

The shell model and interacting boson model for nuclei.

Theory and systematics of nuclear structure.

M. Kugler
fhkugler@weizmann.ac.il

Physical properties of solitons solution.

Bundles of DNA Molecules.

Y. Maron
yitzhak.maron@weizmann.ac.il

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

Z−pinches and plasma switches, spectroscopic diagnostics of plasmas in the visible to x−ray region.
Y. Maron, V. Bernshtam, V. Fisher, Y. Ralchenko, A. Starobinets

Atomic calculations, cross sections and probabilities, field ionization, Stark and Zeeman effects.
Y. Maron, V. Bernshtam, V. Fisher, Y. Ralchenko, A. Starobinets

G. Mikenberg
giora.mikenberg@weizmann.ac.il

Search for the standard−model and SUSY Higgs−bosons at LEP.
G. Mikenberg, E. Duchovni, E. Gross, L. Levinson, D. Lellouch

Detector development and study of physics for LHC.
G. Mikenberg, E. Duchovni, E. Gross, L. Levinson, D. Lellouch

Search for Supersymmetry at LEP.
G. Mikenberg, E. Duchovni, E. Gross, L. Levinson, D. Lellouch

Search for Higgs bosons and SUSY particles at LHC.
G. Mikenberg, E. Duchovni, E. Gross, L. Levinson, D. Lellouch

Trigger and data acquisition for LHC experiments.
G. Mikenberg, E. Duchovni, E. Gross, L. Levinson, D. Lellouch

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

Y. Nir
yosef.nir@weizmann.ac.il

CP violation.
Y. Nir, Quinn, Grossman

Neutrino masses.
Y. Nir, Gonzalez−Garcia

Dynamical Supersymmetry breaking.
Y. Nir, Dine, Shadmi

Particle cosmology
Y. Nir, Berkooz, Waxman, Volansky

I. Tserruya
itzhak.tserruya@weizmann.ac.il

RDof an HBD (Hadron Blind Detector) for the PHENIX experiment
I. Tserruya, I. Ravinovich

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

D. Zajfman
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Molecular astrophysics.
D. Zajfman, O. Heber, Z. Vager

Cooling of molecular ions, ion trap dynamics.
D. Zajfman, O. Heber, Z. Vager

Molecular physics using storage rings.
D. Zajfman, O. Heber, Z. Vager

Molecular structure using Coulomb explosion imaging and laser−induced photodetachment.
D. Zajfman, O. Heber, Z. Vager

Department of Physics of Complex Systems

Adam Schwimmer, 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.

N. Davidson
nir.davidson@weizmann.ac.il

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
eytan.domany@weizmann.ac.il

Computational Physics

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

G. Falkovich
gregory.falkovich@weizmann.ac.il

Cloud turbulence and rain.

Intermittency in Turbulence.

A. Friesem
asher.friesem@weizmann.ac.il

Optical Information Processing.

Diffractive Optical Elements and Planar Optics.

Photonic Devices.

D. Kandel
daniel.kandel@weizmann.ac.il

Dynamics of atomic steps on crystalline surfaces.

Epitaxical growth of strained films.

Exact continuum modeling of discrete systems.

Statistical mechanics of membranes with embedded inclusions.

E. Moses
elisha.moses@weizmann.ac.il

Neuronal Chips.

EEG and Brain Activity.

Motors and Cell Division.

High Resolution Imaging in Cells.

D. Mukamel
david.mukamel@weizmann.ac.il

Systems with long range interactions
D. Mukamel, S. Ruffo

Coarsening processes and slow dynamics.
D. Mukamel, M. Evans, C. Godreche

Collective phenomena in systems far from thermal equilibrium.
D. Mukamel, M. Evans, G. Schutz

Denaturation transition in DNA molecules.
D. Mukamel, L. Peliti, A. Stella, E. Carlon

Wetting phenomena in driven systems
D. Mukamel, H. Hinrichsen, R. Livi, A. Politi

A. Schwimmer
adam.schwimmer@weizmann.ac.il

String theory.

Conformal field theory.

Dynamics of gauge theory.

Y. Silberberg
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Nonlinear optics and soitons.

Ultrafast optics and coherent control.

Nonlinear microscopy.

U. Smilansky
uzy.smilansky@weizmann.ac.il

Quantum chaos.

Chaotic scattering.

Semi−classical quantization.

J. Stavans
joel.stavans@weizmann.ac.il

Single−Molecule Biological Physics.
J. Stavans, Amos Oppenheim

1. Proteins of the bacterial chromosome

2. DNA processing enzymes

Physics of membranes.
J. Stavans, Daniel Kandel

Genetic Networks: the SOS response
J. Stavans, Uri Alon

V. Steinberg
victor.steinberg@weizmann.ac.il

Physical hydrodynamics, pattern dynamics of non−equilibrium systems

1. Hydrodynamics of polymer solutions.

2. Turbulent mixing by polymers.

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

4. Development of measurement of vorticity distribution in a turbulent flow.

5. Convective turbulence in a fluid near the gas−liquid critical point.

6. Microfluidics: mixing, cell separation,chaotic flows.

Feinberg Graduate School

Department of Science Teaching

Abraham Arcavi, 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 an 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.

A. Arcavi
abraham.arcavi@weizmann.ac.il

Research on cognitive characteristics of non academically oriented math students.
A. Arcavi, Dr. Ronnie Karsenty

Design of curriculum materials as a research based activity
A. Arcavi, Dr. Sue Magidson

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

M. Ben−Ari
moti.ben−ari@weizmann.ac.il

Visualization and animation for computer science education

Concurrent and distributed computation

Object−oriented programming in introductory computer science

History and philosophy in science teaching

R. Even
ruhama.even@weizmann.ac.il

MANOR − National center for mathematics teachers:

1. Education and advancement of professional leadership of teachers.

2. Support and counseling to professional development programs and activities in the regional teacher centers.

3. Development of a professional teachers' community.

4. Establishing a resource database.

5. Research and evaluation.

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.

B. Eylon
bat−sheva.eylon@weizmann.ac.il

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.

Research, evaluation and planning
B. Eylon, U. Ganiel

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
B. Eylon, U. Ganiel

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.

Teacher development: National center for physics teachers
B. Eylon, E. Bagno, U. Ganiel

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).

Preparation of learning materials for 7−9 grade

1. Introduction to Science and Technology.

2. Vacuum and particles: The particulate model of matter.

3. About Fibers

4. Interactions, Forces and Motion

5. Scientific and Technological Communication.

6. Projects as Tools for Learning.

7. The Materials' Cycle in Earth's Crust.

8. The World of Water.

Computerized Materials

1. 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".

2. Computer simulations for studying units dealing with "Systems".

3. A Computerized environment for analyzing videotapes of motion.

4. Computer programs accompanying the study of Earth−Sciences in grades 7−9.

5. Computer program accompanying the study of the "cell" as a longitudinal strand (with the Center of Educational Technology).

6. "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).

In−service courses in science and technology for junior−high school teachers
B. Eylon, Z. Scherz, I. Hopfeld, N. Orion, O. Kedem, Y. Ben−Hur

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).

Research and Evaluation
B. Eylon, Z. Scherz, N. Orion, S. Rosenfeld, U. Ganiel

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".

A. Hofstein

avi.hofstein@weizmann.ac.il

Professional development of science teachers (Bi national project with King's College London)
A. Hofstein, Bat−Sheva Eylon

Research and evaluation
A. Hofstein, R. Mamlok and M. Kesner

1. Formative and summative of curriculum units that are developed by the chemistry group and the science for all students
2. Teachers' and students' perceptions and attitudes towards science and technology.
3. Non science oriented students' conception of key ideas and concept in chemistry
4. The development of modules for non−science oriented students
5. Analysis of learning difficulties and misconception in chemistry in the Israeli Bagrut
6. The educational effectiveness of learning chemistry by using the web.

High school chemistry curriculum development and implementation
A. Hofstein, Rachel mamlok−Naaman, Miri Kesner

1. The development and implementation of a text book and teachers' guide
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.
4. Enquiry type experiments.
5. The use of internet for instruction.
6. Development of CAI.
7. Development of introductory (basic) modules for a new syllabus in high school chemistry. (

N. Orion
nir.orion@weizmann.ac.il

The outdoor as a learning environment

1. The educational role of the outdoor learning environment.
2. The cognitive contribution of the outdoor learning environment.
3. Development of in service training model for helping teachers to use the outdoor learning environment effectively.

4. Development of curriculum materials for the outdoor learning environment from K−12.

Earth and environmental sciences education: research, development and implemntation from K−12.

1. Research of cognitive aspects of learning earth and environemtal sciences.

2. Development of curriculum materials for all levels from K−12 based on formative evaluation studies.

3. Development of in service teachers training model for a deep changes in teaching focus and style.

4. Development of curriculum materials in earth sciences for all the learning environments: laboratory, outdoor, computer and classroom.

5. Development of a modules from K−8 based on the Earth systems approach.

6. Development and implementation of learning strategies for classes included high percentage of immegrants.

A. Yarden
anat.yarden@weizmann.ac.il

Study the interplay between procedural and declarative knowledge used by junior−high school students during classification
A. Yarden, B. Eillam

The influence of learning bioinformatics in the high−school biology program on students understanding of basic genetic concepts

1. Development and implementation of learning materials in bioinformatics (http://stwww.weizmann.ac.il/bioinformatics/)

2. Studying the influence of learning modern genetics on students understanding of central genetic concepts.

Understanding of the relationships between cellular processes and function of multicellular organisms at the junior−high school level

1. Development and implementation of learning materials to teach and learn the living cell as a longitudinal axis.

2. Investigating students understanding of the relationships between the micro (cellular and molecular) level and the macro (organism) level when learning the cell topic as a longitudinal axis.

Learning through research papers: development of biological literacy among high−school biology students
A. Yarden, G. Brill

1. Development and processing of scientific research papers as learning materials.

2. Development of instructional strategies for teaching and learning using scientific research papers.

3. Studying the usage of journal−club forums as a means for professional development of biology teachers.

4. Investigating the effect of various text genres on the formation of scientific literacy.

5. Characterizing the learning process of primary literature by high−school biology students.