

CURRICULUM VITAE  
**ARNOLD I. CAPLAN**

**PERSONAL**

Born: January 5, 1942  
Chicago, Illinois

Married: July 4, 1965  
Bonita W. Caplan

Children: Aaron M. Caplan  
Rachel C. Uram

**EDUCATION**

**Illinois Institute of Technology**, Chicago, Illinois 60616, **1959 to 1963.**

B.S., Chemistry, 1963; spent 1½ years working for Dr. A. E. Martell, Chairman, Chemistry Department, on the chelative structure of reduced glutathione.

**The Johns Hopkins University Medical School**, Baltimore, Maryland 21205, **1963 to 1967.**

**1963-1966**, Ph.D., Physiological Chemistry; during the first year of graduate school, participated in a research project, "The Effects of Sr<sup>++</sup> on Swelling and ATP-Linked Contraction of Mitochondria," under the supervision of Dr. Albert L. Lehninger. Thesis work, under the supervision of Dr. J. W. Greenawalt, was concerned with the separation, identification and characterization of the inner and outer mitochondrial membranes. This entailed a combined electron microscopic and biochemical approach.

**1966-1967**, Postdoctoral Fellow with Dr. C. R. Hackenbrock, Department of Anatomy; research was concerned with an investigation of the ultrastructure of isolated, intact mitochondria during various metabolic states. Of primary interest during this time was the ultrastructural state during the process of Ca<sup>++</sup> transport or accumulation by respiring mitochondria. The observations obtained were used to elaborate the general thesis of the ultrastructural basis for energy transfer.

**Brandeis University**, Waltham, Massachusetts 02154, **1967 to 1969.**

**1967-1968**, Postdoctoral Fellow with Dr. N. O. Kaplan, Graduate Department of Biochemistry; in collaboration with Dr. E. Zwilling of the Biology Department, investigation of the effects of nicotinamide-antagonized teratogens on cartilage and muscle development in both *in vitro* and *in vivo* systems.

**1968-1969**, Postdoctoral Fellow with Dr. E. Zwilling, Department of Biology; continuation of work initiated during the previous year.

**WORK HISTORY**

**Case Western Reserve University**, Cleveland, Ohio 44106, **1969 to Present.**

**1981-Present**     **Professor, Department of Biology.**  
Director, Cellular and Molecular Basis of Aging Training Program (ended 2007).

**1986-Present**     **Director, Skeletal Research Center.**  
Professor of General Medical Sciences (Oncology).

**2004-Present**     Professor of Pathology.

**2005- Present**     Professor of Biomedical Engineering.

**1989-2000**         Professor of Physiology and Biophysics.

**1984-1985**         Erna and Jakob Michael Visiting Professor, Department of Biophysics, **Weizmann Institute of Science, Rehovot, Israel.**

**1981-1988**         Professor, Developmental Genetics and Anatomy.

**1976-1977**         (Josiah Macy, Jr. Faculty Scholar Award), Sabbatical Leave, **Faculte de Medecine de Strasbourg, Institute de Chimie Biologique, 67085 Strasbourg CEDEX, France.** In the laboratory of Prof. Pierre Chambon, research involved investigation of chromatin structure and function, especially as related to molecular details of the relationship between poly (ADP-ribose) and other chromatin constituents.

## Case Western Reserve University - Continued

- 1975-1981** Associate Professor, Departments of Biology and Anatomy; Co-Director, Developmental Biology Center; Research involved elucidation of the factors controlling muscle, bone and cartilage development in chick limb mesodermal cells. A working hypothesis was suggested that the local metabolic environment had a profound effect on the choice mechanism(s) governing mesodermal cell differentiation into particular phenotypic pathways. Experimentation attempted to relate such changes in the cell's microenvironment with genomic events, especially the appearance of muscle-, bone- and cartilage-specific macromolecules.
- 1975-1991** Co-Director, Cellular and Molecular Biology Training Program.
- 1973** (Research Career Development Award) Leave of Absence as Visiting Professor, Department of Biochemistry and Biophysics, **University of California Medical School, San Francisco, California 94122**. In collaboration with Dr. Brian J. McCarthy, investigation into the basis of gene selectivity. Attempts were initiated to determine when muscle- and cartilage-specific transcripts first appear in the developing chick limb mesodermal cells.
- 1969-1975** Assistant Professor, Departments of Biology and Anatomy (Medical School).

## HONORS/AWARDS

1. The Genzyme Life-Time Achievement Award given by the International Cartilage Repair Society, October, 2007
2. The Marshall Urist Award for Excellence in Tissue Regeneration Research presented by the Orthopaedic Research Society, February 1999.
3. The Elizabeth Winston Lanier Award given by the American Academy of Orthopaedic Surgeons as part of their 1990 Kappa Delta Awards conferred on February 8, 1990.
4. The Erna and Jakob Michael Visiting Professorship; The Weizmann Institute of Science, Israel, 1984-85.
5. Josiah Macy Faculty Scholar Award, 1976-1977.
6. National Institutes of Health Career Development Award, 1971-1976.
7. American Cancer Society Postdoctoral Fellowship, 1967-1969.
8. Elected Fellow: College of Fellows of the American Institute for Medical and Biological Engineering, Instillation, February 2010.
9. Honorary Member: Stem Cell Research Italy, 2010
10. TERMIS-NA 2010 Lifetime Achievement Award, December 2010

## COMMERCIAL INTERESTS

1. President and Founder, Skeletech, Inc.; 1989-1992.
2. Founder, Chief Scientific Officer, Member of Board of Directors, Osiris Therapeutics, Inc. 1992-1997.
3. Founder, Arnold Caplan and associates, **aCa**, consulting group; 1996-Present
4. Founder, Cell Targeting, Inc., 2004-Present

### **Residence:**

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### **Business:**

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## **PUBLICATIONS**

### **1965**

1. AI Caplan and E Carafoli. The Effects of  $Sr^{++}$  on Swelling and ATP-Linked Contraction of Mitochondria. *Biochem Biophys Acta* 104:317-329 (1965).

### **1966**

2. AI Caplan and JW Greenawalt. Biochemical and Ultrastructural Properties of Osmotically Lysed Rat Liver Mitochondria. *J Cell Biol* 31:455-472 (1966).

### **1968**

3. AI Caplan and JW Greenawalt. The Effects of Osmotic Lysis on the Oxidative Phosphorylation and Compartmentation of Rat Liver Mitochondria. *J Cell Biol* 36:15-31 (1968).
4. AI Caplan, E Zwilling and NO Kaplan. 3-Acetylpyridine: Effects In Vitro Related to Teratogenic Activity in Chick Embryos. *Science* 160:1009-1010 (1968).

### **1969**

5. CR Hackenbrock and AI Caplan. Ion-Induced Ultrastructural Transformations in Isolated Mitochondria. *J Cell Biol* 42:221-234 (1969).

### **1970**

6. AI Caplan. Effects of the Nicotinamide-Sensitive Teratogen 3-Acetylpyridine on Chick Limb Cells in Culture. *Exp Cell Res* 62:341-355 (1970).

### **1971**

7. AI Caplan. The Teratogenic Action of the Nicotinamide Analogs 3-Acetylpyridine and 6-Aminonicotinamide on Developing Chick Embryos. *J Exp Biol* 178:351-358 (1971).

### **1972**

8. AI Caplan. Effects of a Nicotinamide-Sensitive Teratogen 6-Aminonicotinamide on Chick Limb Cells in Culture. *Exp Cell Res* 70:185-195 (1972).
9. AI Caplan. The Effects of the Nicotinamide-Sensitive Teratogen 3-Acetylpyridine on Chick Limb Mesodermal Cells in Culture: Biochemical Parameters. *J Exp Zool* 180:351-362 (1972).
10. AI Caplan. Comparison of the Capacity of Nicotinamide and Nicotinic Acid to Relieve the Effects of Muscle and Cartilage Teratogens in Developing Chick Embryos. *Dev Biol* 28:344-351 (1972).
11. AI Caplan. The Site and Sequence of Action of 6-Aminonicotinamide in Causing Bone Malformations of Embryonic Chick Limb and Its Relationship to Normal Development. *Dev Biol* 28:71-83 (1972).

### **1973**

12. AI Caplan and S Koutroupas. The Control of Muscle and Cartilage Development in the Chick Limb: The Role of Differential Vascularization. *J Embryol Exp Morph.* 29:571-583 (1973).
13. AI Caplan and AC Stoolmiller. Control of Chondrogenic Expression in Mesodermal Cells of Embryonic Chick Limb. *Proc Natl Acad Sci* 70:1712-1717 (1973).

### **1974**

14. MJ Rosenberg and AI Caplan. Nicotinamide Adenine Dinucleotide Levels in Cells of Developing Chick Limbs: Possible Control of Muscle and Cartilage Development. *Dev Biol* 38:157-164 (1974).

### **1975**

15. MJ Rosenberg and AI Caplan. Nicotinamide Adenine Dinucleotide Levels in Chick Limb Mesodermal Cells In Vitro: Effects of 3-Acetylpyridine and Nicotinamide. *J Embryol Exp Morph* 33:947-956 (1975).
16. AI Caplan and MJ Rosenberg. Interrelationship Between Poly(Adenosine Diphosphoribose) Synthesis, Intracellular NAD Levels, and Muscle or Cartilage Differentiation from Embryonic Chick Limb Mesodermal Cells. *Proc Natl Acad Sci* 72:1852-1857 (1975).
17. AI Caplan and MJ Rosenberg. The Control of Chondrogenic and Myogenic Expression in Chick Limb Mesodermal Cells. In: *Extracellular Matrix Influences on Gene Expression*, Ed. H.C. Slavkin and R. Greulich, Academic Press, New York, pp. 47-55 (1975).
18. AI Caplan. Biochemical Influences on Organ and Tissue Differentiation. In: *7th Mead Johnson Symposium in Perinatal and Developmental Medicine: Clinical and Biological Aspects of Malformation*, Ed. R.S. Bloom, J.C. Sinclair and J.B. Warshaw, pp. 38-53 (1975).

## 1976

19. VC Hascall, TR Oegema, M Brown and AI Caplan. Isolation and Characterization of Proteoglycans from Avian Embryonic Limb Bud Chondrocytes Grown In Vitro. *J Biol Chem* 251:3511-3519 (1976).
20. P Osdoby and AI Caplan. The Possible Differentiation of Osteogenic Elements In Vitro from Chick Limb Mesodermal Cells: I. Morphological Evidence. *Dev Biol* 52:283-299 (1976).
21. CP Ordahl and AI Caplan. Transcriptional Diversity in Myogenesis. *Dev Biol* 54:61-72 (1976).
22. CP Ordahl, TR Johnson and AI Caplan. Sheared DNA Fragment Sizing: Comparison of Techniques. *Nucl Acids Res* 3:2985-2999 (1976).
23. AI Caplan. Simplified Procedure for Preparing Myogenic Cells for Culture. *J Embryol Exp Morph* 36:175-181 (1976).

## 1977

24. S DeLuca, D Heinegard, VC Hascall, JH Kimura and AI Caplan. Chemical and Physical Changes in Proteoglycans During Development of Chick Limb Bud Chondrocytes Grown In Vitro. *J Biol Chem* 252:6600-6608 (1977).
25. AI Caplan. Muscle, Cartilage and Bone Development and Differentiation from Chick Limb Mesenchymal Cells. In: *Vertebrate Limb and Somite Morphogenesis*. Ed. DA Ede, JR Hinchliffe and M Balls, Cambridge University Press, Cambridge, England, pp. 199-213 (1977).

## 1978

26. AI Caplan. Molecular Basis for Limb Morphogenesis. In: *5th International Conference on Birth Defects*, Ed. J Littlefield and J DeGrouchy, Excerpt. Medica. pp. 208-220 (1978).
27. JH Kimura, P Osdoby, AI Caplan and VC Hascall. Electron Microscopic and Biochemical Studies of Proteoglycan Polydispersity in Chick Limb Bud Chondrocyte Cultures. *J Biol Chem* 253:4721-4729 (1978).
28. JE Zull, S Krug, D Abel and AI Caplan. Development of Parathyroid Hormone and Calcitonin-Activated Adenylate Cyclases in the Embryonic Limb and in Cultured Cells from Embryonic Chick Limb. *Proc Natl Acad Sci* 75:3871-3875 (1978).
29. S DeLuca, AI Caplan and VC Hascall. Biosynthesis of Proteoglycans by Chick Limb Bud Chondrocytes. *J Biol Chem* 253:4713-4720 (1978).
30. AI Caplan and CP Ordahl. Irreversible Gene Repression Model for Control of Development. *Science* 201:120-130 (1978).
31. JE Saffitz and AI Caplan. Separation of Transcriptionally Active and Inactive Chromatin: Agarose Gel Chromatography. *Biochem Biophys Acta* 520:368-375 (1978).
32. AI Caplan, MG Ord and LA Stocken. Chromatin Structure Through the Cell Cycle: Studies With Regenerating Rat Liver. *Biochem J* 174:475-483 (1978).
33. JE Saffitz and AI Caplan. Hydroxylapatite Thermal Fractionation of Chromatin and DNA. *Biochem* 17:3480-3486 (1978).

## **PUBLICATIONS**- Continued

34. JE Saffitz and AI Caplan. Attempted Separation of Transcriptionally Active and Inactive Chromatin by Hydroxylapatite Thermal Chromatography. *Biochem* 17:3487-3495 (1978).
35. CP Ordahl and AI Caplan. High Diversity in the Polyadenylated RNA Populations of Embryonic Myoblasts. *J Biol Chem* 253:7683-7691 (1978).
36. JH Kimura and AI Caplan. Identification of Glycogen as the Major Xylose Acceptor in Polysomal Preparations from Chick Embryo Cartilage Cultures. *Arch Biochem Biophys* 191:687-697 (1978).

## **1979**

37. AI Caplan, C Neidergang, H Okazaki and P Mandel. Poly(ADP-ribose) Levels as a Function of Chick Limb Mesenchymal Cell Development as Studied In Vitro and In Vivo. *Dev Biol* 72:102-109 (1979).
38. P Osdoby and AI Caplan. Osteogenesis in Cultures of Limb Mesenchymal Cells. *Dev Biol* 73:84-102 (1979).
39. LS Lohmander, VC Hascall and AI Caplan. Effects of 4-Methyl Umbelliferyl- $\beta$ -D-Xylopyranoside on Chondrogenesis and Proteoglycan Synthesis in Chick Limb Bud Mesenchymal Cell Cultures. *J Biol Chem* 254:10551-10561 (1979).
40. JH Kimura, P Osdoby, AI Caplan and VC Hascall. Electron Microscopic Examination of Isolated Proteoglycan Aggregates. In: *Glycoconjugate Research*, Vol. I, Ed. JO Gregory, RW Jeanloz, Academic Press, New York, pp. 189-192 (1979).
41. AI Caplan, C Neidergang, H Okazaki and P Mandel. Poly(ADP-ribose) Polymerase: Self-ADP-ribosylation, the Stimulation by DNA and the Effects on Nucleosome Formation and Stability. *Arch Biochem Biophys* 198:60-69 (1979).
42. LS Lohmander, VC Hascall and AI Caplan. Effects of  $\beta$ -D-Xyloside on Chondrogenesis and Proteoglycan Synthesis in Chick Limb Bud Cell Cultures. In: *Proc. of 2nd Munich Symposium on Biology of Connective Tissue: Biology of the Articular Cartilage in Health and Disease*, (1979).

## **1980**

43. AI Caplan and VC Hascall. Structure and Development Changes in Proteoglycans. In: *Dilatation of the Uterine Cervix*, Ed. F Naftolin and PG Stubblefield, Raven Press, New York, pp. 79-98 (1980).
44. P Osdoby and AI Caplan. Scanning Electron Microscopy of In Vitro Osteogenesis. *Calcif Tiss Intl* 30:43-50 (1980).
45. S DeLuca, LS Lohmander, B Nilsson, VC Hascall and AI Caplan. Proteoglycans from Chick Limb Bud Chondrocyte Cultures: Keratan Sulfate and Oligosaccharides which Contain Mannose and Sialic Acid. *J Biol Chem* 255:6077-6083 (1980).

## **1981**

46. AI Caplan. Embryological Development: Evolutionary History, Genetic Bias and Cellular Environment Control the Flow of Developmental Events. *J Col Sci Teach* 10:226-230; 289-293 (1981).
47. AI Caplan. Studies on the Role of NAD and Poly(ADP-ribose) in the Control of the Differentiation and Development of Embryonic Chick Limb Cells. In: *Novel ADP-Ribosylation of Regulatory Enzymes and Proteins*, Ed. T Sigamura and M Smulson, Elsevier, North Holland, pp. 315-324 (1981).
48. RL Stevens, SP Nissley, JH Kimura, M Rechler, AI Caplan and VC Hascall. Effects of Insulin and Multiplication-Stimulating Activity on Proteoglycan Biosynthesis in Chondrocytes from the Swarm Rat Chondrosarcoma. *J Biol Chem* 256:2045-2052 (1981).
49. AI Caplan. The Molecular Control of Muscle and Cartilage Development. In: *39th Annual Symposium of the Society for Developmental Biology*, Ed. S Subtelney and U Abbott, Alan R. Liss, Inc., New York, pp. 37-68 (1981).
50. P Osdoby and AI Caplan. First Bone Formation in Embryonic Chick Limbs. *Dev Biol* 86:147-156 (1981).

## PUBLICATIONS - Continued

51. P Osdoby and AI Caplan. Characterization of a Bone-Specific Alkaline Phosphatase in Cultures of Chick Limb Mesenchymal Cells. *Dev Biol* 86:136-146 (1981).
52. JE Zull, K Youngman and AI Caplan. The Development of Hormonal Responses of Cultured Embryonic Chick Limb Mesenchymal Cells. *Dev Biol* 86:61-68 (1981).

## 1982

53. K von der Mark, P Osdoby and AI Caplan. Effect of 4-Methyl Umbelliferyl- $\beta$ -D-Xyloside on Collagen Synthesis in Chick Limb Bud Mesenchymal Cell Cultures. *Dev Biol* 90:24-30 (1982).
54. MJ Katz, RJ Lasek, P Osdoby, JR Whittaker and AI Caplan. Bolton-Hunter Reagent as a Vital Stain for Developing Systems. *Dev Biol* 90:419-429 (1982).
55. DA Carrino and AI Caplan. Isolation and Preliminary Characterization of Proteoglycans Synthesized by Skeletal Muscle. *J Biol Chem* 257:14145-14154 (1982).
56. BW Cherney, RJ Midura and AI Caplan. Poly(ADP-ribose) and the Differentiation of Embryonic Tissue. In: *ADP-Ribosylation Reactions: Biology and Medicine*, Ed. O Hayaishi and K Ueda, Academic Press, New York, pp. 389-406 (1982).
57. CP Ordahl, T Cooper, C Ovitt, J Fornwald, AI Caplan and A Calman. Structure and Developmental Regulation of Muscle-Regulated Gene Sets. In: *Cold Spring Harbor Symposium, Muscle Development: Molecular and Cellular Control*. Ed. ML Pearson and HF Epstein (1982).
58. R Shogren, AM Jamieson, J Blackwell, DA Carrino and AI Caplan. Light Scattering Studies of Chick Limb Bud Proteoglycans. *J Biol Chem* 257:8627-8629 (1982).
59. P Osdoby, MC Martini and AI Caplan. Isolated Osteoclasts and Their Presumed Progenitor Cells, the Monocyte, in Culture. *J Exp Biol* 224:331-344 (1982).
60. MC Martini, P Osdoby and AI Caplan. Adhesion of Osteoclasts and Monocytes to Developing Bone. *J Exp Biol* 224:345-354 (1982).

## 1983

61. SJ Hunter and AI Caplan. The Control of Cartilage Differentiation. In: *Cartilage, Vol. II, Development and Differentiation*, Ed. BK Hall, Academic Press, New York, pp. 87-120 (1983).
62. P Osdoby, MC Martini and AI Caplan. The Development of Long Bones of the Limb: Cell and Matrix Interactions of Osteoclasts and Monocytes. In: *Limb Development and Regeneration, Part B*, Ed. RO Kelly, PF Goetinck and JA MacCabe, Alan R. Liss, Inc., New York, pp. 229-238 (1983).
63. DM Jargiello and AI Caplan. The Fluid Flow Dynamics in the Developing Chick Wing. In: *Limb Development and Regeneration, Part A*, Ed. JF Fallon and AI Caplan, Alan R. Liss, Inc., New York, pp. 143-154 (1983).
64. DA Carrino and AI Caplan. Proteoglycans Produced by Skeletal Muscle In Vitro and In Vivo. In: *Limb Development and Regeneration, Part B*, Ed. RO Kelly, PF Goetinck and JA MacCabe, Alan R. Liss, Inc., New York, pp. 379-390 (1983).
65. AI Caplan, GT Syftestad and P Osdoby. The Development of Bone and Cartilage in Tissue Culture. *J Clin Ortho Rel Res.* 174:243-263 (1983).
66. DM Jargiello and AI Caplan. The Establishment of Vascular-Derived Micro-Environments in the Developing Chick Wing. *Dev Biol* 97:364-374 (1983).
67. DP Lennon, P Osdoby, DA Carrino, BM Vertel and AI Caplan. Isolation and Characterization of Chondrocytes and Non-Chondrocytes from High-Density Chick Limb Bud Cell Cultures. *J Craniofac Genet Develop Biol* 3:235-251 (1983).
68. DA Carrino, DP Lennon and AI Caplan. Extracellular Matrix and the Maintenance of the Differentiated State: Proteoglycans Synthesized by Replated Chondrocytes and Non-Chondrocytes. *Dev Biol* 99:132-144 (1983).
69. AI Caplan, MY Fisman and HM Eppenberger. Molecular and Cell Isoforms During Development. *Science* 221:921-927 (1983).

## PUBLICATIONS - Continued

70. RL Shogren, J Blackwell, AM Jamieson, DA Carrino, DG Pechak and AI Caplan. Light-Scattering Studies of Chick Limb Bud Proteoglycan Aggregate. *J Biol Chem* 258:8627-8629 (1983).

## 1984

71. AI Caplan. Cartilage. *Scientific American* 251:84-94 (1984).
72. DA Carrino, DG Pechak and AI Caplan. Characterization of Proteoglycans which are Synthesized During Skeletal Muscle Development. In: *Developmental Processes in Normal and Diseased Muscle*, Ed. H Eppenberger and J-C Perriard: Vol. 9 of *Experimental Biology and Medicine*, Ed. A Wolsky, S Karger, Publishers, Basel, Switzerland, pp. 80-86 (1984).
73. GT Syftestad and AI Caplan. A Fraction from Extracts from Demineralized Bone Stimulates the Conversion of Mesenchymal Cells into Chondrocytes. *Dev Biol* 104:348-356 (1984).
74. GT Syftestad and AI Caplan. Effects of Osteoinductive Bone Matrix Extracts on the Transition of Mesenchymal Cells into Chondrocytes. *Calc Tiss Intl* 36:625-627 (1984).
75. DA Carrino and AI Caplan. Isolation and Partial Characterization of High-Buoyant-Density Proteoglycans Synthesized In Ovo by Embryonic Chick Skeletal Muscle and Heart. *J Biol Chem* 259:12419-12430 (1984).

## 1985

76. DA Carrino and AI Caplan. Isolation and Characterization of Proteoglycans Synthesized In Ovo by Embryonic Chick Cartilage and New Bone. *J Biol Chem* 260:122-127 (1985).
77. AI Caplan. The Vasculature and Limb Development. *Cell Diff* 16:1-11 (1985).
78. DG Pechak, DA Carrino and AI Caplan. Electron Microscopic Characterization of Chick Embryonic Skeletal Muscle Proteoglycans. *J Cell Biol* 100:1767-1776 (1985).
79. RF Drushel, DG Pechak and AI Caplan. The Anatomy, Ultrastructure and Fluid Dynamics of the Developing Vasculature of the Embryonic Chick Wing Bud. *Cell Diff* 16:13-28 (1985).
80. AI Caplan. Poly(ADP-ribose)Synthetase and Cell Differentiation. In: *ADP-Ribosylation of Proteins*, Ed. F Althaus, H Hilz and S Shall, Springer-Verlag, Berlin, pp. 388-396 (1985).
81. GT Syftestad, M Weitzhandler and AI Caplan. Isolation and Characterization of Osteogenic Cells Derived from First Bone of the Embryonic Tibia. *Dev Biol* 110:275-283 (1985).
82. DA Carrino, M Weitzhandler and AI Caplan. Proteoglycans Synthesized During the Cartilage to Bone Transition. In: *The Chemistry and Biology of Mineralized Tissues*, Ed. WT Butler, Ebsco Media, Inc., Birmingham, Alabama, pp. 197-208 (1985).
83. RJ Midura, BW Cherney and AI Caplan. The Relationship of Nicotinamide Adenine Dinucleotide to the Chondrogenic Differentiation of Limb Mesenchymal Cells. *Dev Biol* 111:232-242 (1985).
84. BW Cherney, RJ Midura and AI Caplan. Poly(ADP-ribose) Synthetase and Chick Limb Mesenchymal Cell Differentiation. *Dev Biol* 112:115-125 (1985).
85. GT Syftestad, PA Lucas and AI Caplan. The In Vitro Chondrogenic Response of Limb Bud Mesenchyme to a Water-Soluble Fraction Prepared from Demineralized Bone Matrix. *Differentiation* 29:230-237 (1985).

## 1986

86. DA Carrino and AI Caplan. Proteoglycan Synthesis During Skeletal Muscle Development. In: *Molecular Biology of Muscle Development, UCLA Symposia on Molecular and Cellular Development*, Vol. 29, Ed. C Emerson, DA Fischman, B Nadal-Ginard and MAQ Siddiqui, Alan R. Liss, Inc., New York, pp. 117-132 (1986).
87. MJ Kujawa, DG Pechak, MY Fisman and AI Caplan. Hyaluronic Acid Bonded to Cell Culture Surfaces Inhibits the Program of Myogenesis. *Dev Biol* 113:10-16 (1986).
88. H Ohno, J Blackwell, AM Jamieson, DG Pechak, DA Carrino and AI Caplan. Structure of Native Proteoglycan Aggregates from Chick Limb Bud Chondrocytes. *Biopolymers* 25:931-946 (1986).

## **PUBLICATIONS - Continued**

89. MJ Kujawa and AI Caplan. Hyaluronic Acid Bonded to Cell Culture Surfaces Stimulates Chondrogenesis in Stage 24 Limb Mesenchyme Cell Cultures. *Dev Biol* 114:504-518 (1986).
90. AI Caplan. Molecular and Cellular Differentiation of Muscle, Cartilage and Bone in the Developing Limb. In: *Progress in Developmental Biology Part B, Progress in Clinical and Biological Research*. Vol. 217B, Ed. HC Slavkin, Alan R. Liss, Inc., New York, pp. 307-318 (1986).
91. MJ Kujawa, DA Carrino and AI Caplan. Substrate-Bonded Hyaluronic Acid Exhibits a Size-Dependent Stimulation of Chondrogenic Differentiation of Stage 24 Limb Mesenchymal Cells in Culture. *Dev Biol* 114:519-528 (1986).
92. AI Caplan. The Extracellular Matrix is Instructive. *BioEssays* 5:129-132 (1986).
93. PA Lucas, GT Syftestad and AI Caplan. Partial Isolation and Characterization of a Chemotactic Factor from Adult Bone for Mesenchymal Cells. *Bone* 7:365-371 (1986).
94. H Ohno, J Blackwell, AM Jamieson, DA Carrino and AI Caplan. Calibration of the Relative Molecular Mass of Proteoglycan Subunit by Column Chromatography on Sepharose CL-2B. *Biochem J* 235:553-557 (1986).
95. DG Pechak, MJ Kujawa and AI Caplan. Morphological and Histological Events During First Bone Formation in Embryonic Chick Limbs. *Bone* 7:441-458 (1986).
96. DG Pechak, MJ Kujawa and AI Caplan. Morphology of Bone Development and Bone Remodeling in Embryonic Chick Limbs. *Bone* 7:459-472 (1986).

## **1987**

97. AI Caplan. Bone Development and Repair. *BioEssays* 6:171-175 (1987).
98. AI Caplan and DG Pechak. The Cellular and Molecular Embryology of Bone Formation. In: *Bone and Mineral Research*, Vol. 5, Ed. WA Peck, Elsevier, New York, pp. 117-184 (1987).
99. AM Jamieson, J Blackwell, H Reihanian, H Ohno, R Gupta, DA Carrino, AI Caplan, LH Tang and LC Rosenberg. Thermal and Solvent Stability of Proteoglycan Aggregates by Quasielastic Laser Light-Scattering. *Carbohydr Res* 160:329-342 (1987).
100. SE Haynesworth, DA Carrino and AI Caplan. Characterization of the Core Protein of the Large Chondroitin Sulfate Proteoglycan Synthesized by Chondrocytes in Chick Limb Bud Cell Cultures. *J Biol Chem* 262:10574-10581 (1987).
101. AR Poole and AI Caplan. An Appreciation: Dame Honor B. Fell, R.F.S. (1900-1986). *Dev Biol* 122:297-299 (1987).
102. GT Syftestad, PA Lucas, H Ohgushi and AI Caplan. Chondrogenesis as an In Vitro Response to Bioactive Factors Extracted from Adult Bone and Non-Skeletal Tissues. In: *UCLA Symposium Volume, Development and Diseases of Cartilage and Bone Matrix*, Ed. T Thornhill and A Senn, Alan R. Liss, Inc., New York, pp. 187-199 (1987).

## **1988**

103. HE Young, DA Carrino and AI Caplan. Initial Characterization of Small Proteoglycans Synthesized by Embryonic Chick Leg Muscle-Associated Connective Tissues. *Conn Tiss Res* 17:99-118 (1988).
104. H Ohgushi, GT Syftestad and AI Caplan. In Vitro Chondrogenesis Stimulated by Extracts of Gall Bladder Epithelium. *Bone* 8:375-379 (1988).
105. RF Drushel and AI Caplan. The Extravascular Fluid Dynamics of the Chick Wing Bud. *Dev Biol* 126:7-18 (1988).
106. PA Lucas, GT Syftestad and AI Caplan. A Water-Soluble Fraction from Adult Bone Stimulates the Differentiation of Cartilage in Explants of Embryonic Muscle. *Differentiation* 37:47-52 (1988).
107. PA Lucas and AI Caplan. Chemotactic Response of Embryonic Limb Bud Mesenchymal Cells and Muscle-Derived Fibroblasts to Transforming Growth Factor Beta. *Conn Tiss Res* 18:1-7 (1988).
108. AI Caplan. Biomaterials and Bone Repair. *BIOMAT* 87:15-24 (1988).

## PUBLICATIONS - Continued

109. DA Carrino and AI Caplan. Extracellular Matrix and Sequential Replacement Events During Tissue Formation, Remodeling and Repair. In: *The Biology of Tooth Movement*, Ed. LA Norton and CJ Burstone, CRC Press, Inc., Boca Raton, Florida, Chapter 11, pp. 183-194 (1988).
110. AI Caplan. Bone Development. In: *Cell and Molecular Biology of Vertebrate Hard Tissues*. CIBA Foundation Symposium 136, Wiley, Chichester, pp. 3-21 (1988).
111. M Weitzhandler, DA Carrino and AI Caplan. Proteoglycans Synthesized During the Cartilage-to-Bone Transition in Developing Chick Embryos. *Bone* 9:225-233 (1988).
112. AI Caplan. Cell and Molecular Strategies for Massive Bone Repair/Regeneration, Japanese Orthopaedic Research Society, Special Lectures at a Glance, Tokyo, Japan, pp. 97-104 (1988).
113. DA Carrino, U Oron, DG Pechak and AI Caplan. Reinitiation of Embryonic Chondroitin Sulfate Proteoglycan Synthesis in Regenerating Skeletal Muscle. *Development* 103:641-656 (1988).
114. AI Caplan, BM Carlson, JA Faulkner, DA Fischman and WE Garrett, Jr. Skeletal Muscle. In: *Injury and Repair of the Musculoskeletal Soft Tissue*. Ed. SL-Y Woo and JA Buckwalter, American Academy of Orthopaedic Surgeons, pp. 209-291 (1988).
115. PA Lucas, PA Price and AI Caplan. Chemotactic Response of Mesenchymal Cells, Fibroblasts and Osteoblast-like Cells to Bone GLA Protein. *Bone* 9:319-323 (1988).

## 1989

116. MJ Kujawa, M Weitzhandler, AR Poole, L Rosenberg and AI Caplan. Association of the C-Propeptide of Type II Collagen with Mineralization of Embryonic Chick Long Bone and Sternal Development. *Conn Tiss Res* 23:179-199 (1989).
117. H Ohgushi, VM Goldberg and AI Caplan. Heterotopic Osteogenesis in Porous Ceramics Induced by Marrow Cells. *J Ortho Res* 7:568-578 (1989).
118. SP Bruder and AI Caplan. Discrete Stages Within the Osteogenic Lineage are Revealed by Alterations in the Cell Surface Architecture of Embryonic Bone Cells. In: *The Chemistry and Biology of Mineralized Tissue*, Ed. MJ Glimcher and JB Lian, Gordon and Breach, New York, pp. 73-79 (1989).
119. DA Carrino, C Lidor, S Edelstein and AI Caplan. Proteoglycan Synthesis in Vitamin D-Deficient Cartilage: Recovery from Vitamin-D Deficiency. *Conn Tiss Res* 19:135-147 (1989).
120. SP Bruder and AI Caplan. First Bone Formation and the Dissection of an Osteogenic Lineage in the Embryonic Chick Tibia is Revealed by Monoclonal Antibodies Against Osteoblasts. *Bone* 10:359-375 (1989).
121. PA Lucas, GT Syftestad, VM Goldberg and AI Caplan. Ectopic Induction of Cartilage and Bone by Water-Soluble Proteins from Bovine Bone Using a Collagenous Delivery Vehicle. *J Biomed Matl Res* 23:23-39 (1989).
122. SP Bruder and AI Caplan. Cellular and Molecular Events During Embryonic Bone Development. In: *The Chemistry and Biology of Mineralized Tissue*, Ed. MJ Glimcher and JB Lian, Gordon and Breach, New York, pp. 65-71 (1989).
123. H Ohgushi, VM Goldberg and AI Caplan. Repair of Bone Defects with Marrow Cells and Porous Ceramic. *Acta Scandia Ortho* 60:334-339 (1989).
124. SP Bruder and AI Caplan. Cellular and Molecular Events During Embryonic Bone Development. *Conn Tiss Res* 20:65-71 (1989).
125. DA Carrino and AI Caplan. Structural Characterization of Skeletal Muscle Chondroitin Sulfate Proteoglycan. *Conn Tiss Res* 19:35-50 (1989).
126. SP Bruder and AI Caplan. Discrete Stages Within the Osteogenic Lineage are Revealed by Alterations in the Cell Surface Architecture of Embryonic Bone Cells. *Conn Tiss Res* 20:73-79 (1989).
127. HE Young, DA Carrino and AI Caplan. Analysis of Newly Synthesized and Accumulated Sulfated Glycosaminoglycans During Musculogenesis in the Embryonic Chick Leg. *J Morph* 201:85-103 (1989).
128. MJ Kujawa, DP Lennon and AI Caplan. Growth and Differentiation of Stage 24 Limb Mesenchymal Cells in a Serum-Free, Chemically Defined Medium. *Exp Cell Res* 183:45-61 (1989).

## PUBLICATIONS - Continued

129. AI Caplan. Bioactive Factors in Bone: Marshall R. Urist, M.D. May 1988, Kerrville, Texas. *Conn Tiss Res* 23:103-106 (1989).
130. HE Young, VE Young and AI Caplan. Comparison of Fixatives for Maximal Retention of Radiolabeled Glycoconjugates for Autoradiography, Including Use of Sodium Sulfate to Release Unincorporated [<sup>35</sup>S]Sulfate. *J Histochem Cytochem* 37:223-228 (1989).
131. H Ohgushi, M Okumura, K Masuhara, VM Goldberg, DT Davy and AI Caplan. Calcium Phosphate Block Ceramic with Bone Marrow Cells Improves Repair of Rat Long Bone Defect" and "Osteogenic Potential of Bone Marrow Sustained by Porous Calcium Phosphate Ceramics. In: *Handbook of Bioactive Ceramics, Volume II: Calcium Phosphate and Hydroxylapatite Ceramics*, Ed. T Yamamuro, LL Hench and J Wilson-Herch, CRC Press, Inc., Boca Raton, Florida, (1989).
132. DA Carrino, MJ Kujawa, DP Lennon and AI Caplan. Altered Proteoglycans Synthesized by Chick Limb Bud Chondrocytes Cultured in Serum-Free Defined Medium. *Exp Cell Res* 183:62-77 (1989).
133. AI Caplan. Cell Delivery and Tissue Regeneration. *J Contr Release* 11:157-165 (1989).

## 1990

134. DM Snow, V Lemmon, DA Carrino, AI Caplan and J Silver. Sulfated Proteoglycans in Astroglial Barriers Inhibit Neurite Outgrowth In Vitro. *Exp Neurol* 109:111-130 (1990).
135. SP Bruder and AI Caplan. A Monoclonal Antibody Against the Surface of Osteoblasts Recognizes Alkaline Phosphatase Isoenzymes in Bone, Liver, Kidney and Intestine. *Bone* 11:133-139 (1990).
136. H Nakahara, SP Bruder, VM Goldberg and AI Caplan. In Vivo Osteochondrogenic Potential of Cultured Cells Derived from the Periosteum. *Clin Ortho Rel Res* 259:223-232 (1990).
137. HE Young, DA Carrino and AI Caplan. Change in Synthesis of Sulfated Glycoconjugates During Muscle Development, Maturation and Aging in CBF-1 Mouse. *Mech Aging Develop* 53:179-193 (1990).
138. T Rabinowitz, GT Syftestad and AI Caplan. Chondrogenic Stimulation of Embryonic Chick Limb Mesenchymal Cells by Bioactive Factors in Bovine and Human Dentine Extracts. *Arch Oral Biol* 35:49-54 (1990).
139. AI Caplan. Cartilage Begets Bone Versus Endochondral Myelopoiesis. *Clin Ortho Rel Res* 261:257-267 (1990).
140. JE Dennis, DA Carrino, NB Schwartz and AI Caplan. Ultrastructural Characterization of Embryonic Chick Cartilage Proteoglycan Core Protein and the Mapping of a Monoclonal Antibody Epitope. *J Biol Chem* 265:12098-12103 (1990).
141. SP Bruder and AI Caplan. Osteogenic Cell Lineage Analysis is Facilitated by Organ Culture of Embryonic Chick Periosteum. *Dev Biol* 141:319-329 (1990).
142. JM Sorrell, B Caterson, AI Caplan, BR Davis and IA Schafer. Human Keratinocytes Contain Carbohydrates that Are Recognized by Keratan Sulfate-Specific Monoclonal Antibodies. *J Invest Derm* 95:347-352 (1990).
143. AI Caplan. Stem Cell Delivery Vehicle. *Biomaterials* 11:44-46 (1990).
144. SP Bruder and AI Caplan. Terminal Differentiation of Osteogenic Cells in the Embryonic Chick Tibia is Revealed by a Monoclonal Antibody Against Osteocytes. *Bone* 11:189-198 (1990).
145. AI Caplan. Bone Formation: The Rules for Fabricating a Composite Ceramic. In: *Materials Synthesis Utilizing Biological Processes*, Ed. PC Rieke, PD Calvert and M Alper, Materials Research Society Symposium Proceedings, Vol. 174, pp. 9-13 (1990).
146. SP Bruder, D Gazit, L Passi-Even, I Bab and AI Caplan. Osteochondral Differentiation of Avian Bone Marrow Cells in Diffusion Chambers In Vivo. *Bone and Mineral* 11:141-151 (1990).
147. PA Lucas, C Laurencin, GT Syftestad, A Domb, VM Goldberg, AI Caplan and R Langer. Ectopic Induction of Cartilage and Bone by Water-Soluble Proteins from Bovine Bone Using a Polyanhydride Delivery Vehicle. *J Biomed Matl Res* 24:901-911 (1990).

## PUBLICATIONS - Continued

148. H Nakahara, K Watanabe, SP Sugrue, BR Olsen and AI Caplan. Temporal and Spatial Distribution of Type XII Collagen in High Cell Density Culture of Periosteal-Derived Cells. *Dev Biol* 142:481-485 (1990).
149. H Nakahara, SP Bruder, SE Haynesworth, JJ Holecek, MA Baber, VM Goldberg and AI Caplan. Bone and Cartilage Formation in Diffusion Chambers by Subcultured Cells Derived from the Periosteum. *Bone* 11:181-188 (1990).
150. H Ohgushi, M Okumura, S Tamai, EC Shors and AI Caplan. Marrow Cell Induced Osteogenesis in Porous Hydroxyapatite and Tricalcium Phosphate. *J Biomed Matl Res* 24:1563-1570 (1990).

## 1991

151. JL Arias, MS Fernandez, JE Dennis and AI Caplan. Collagens of the Chicken Eggshell Membranes. *Conn Tiss Res* 26:37-45 (1991).
152. J Goshima, VM Goldberg and AI Caplan. The Origin of Bone Formed in Composite Grafts of Porous Calcium Phosphate Ceramic Loaded with Marrow Cells. *Clin Ortho Rel. Res* 269:274-283 (1991).
153. SP Bruder, AI Caplan, Y Gotoh, LC Gerstenfeld and MJ Glimcher. Immunohistochemical Localization of a ~66kD Glycosylated Phosphoprotein During Development of the Embryonic Chick Tibia. *Calcif Tiss Intl* 48:429-437 (1991).
154. H Nakahara, VM Goldberg and AI Caplan. Culture-Expanded Human Periosteal-Derived Cells Exhibit Osteochondral Potential In Vivo. *J Ortho Res* 9:465-476 (1991).
155. AI Caplan. Extracellular Matrix and Muscle Formation. In: *Developmental Pattern of the Vertebrate Limb*, Ed. JR Hinchliffe, J Hurler and D Summerbell, Plenum Pub., New York, pp. 285-292 (1991).
156. JL Arias, MS Fernandez, VJ Laraia, Jr., J Janicki, AH Heuer and AI Caplan. The Avian Eggshell as a Model of Biomineralization. In: *Materials Synthesis Utilizing Biological Processes*, Ed. PC Rieke, Materials Research Society Symposium Proceedings, Pittsburgh, Pennsylvania, 218:193-199 (1991).
157. AI Caplan. Mesenchymal Stem Cells. *J Ortho Res* 9:641-650 (1991).
158. RW Moskowitz, JH Reese, RG Young, D Fein-Krantz, CJ Malemud and AI Caplan. The Effect of Rumalon, a Glycosaminoglycan Peptide-Complex (GP-C), on Experimentally Induced Osteoarthritis in Rabbits. *J Rheumatol* 18:205-209 (1991).
159. MD Willen, JM Sorrell, CC Lekan, BR Davis and AI Caplan. Patterns of Glycosaminoglycan/Proteoglycan Immunostaining in Human Skin During Aging. *J Invest Derm* 96:968-974 (1991).
160. RF Drushel and AI Caplan. Three-Dimensional Reconstruction and Cross-Sectional Anatomy of the Thigh Musculature of the Developing Chick Embryo (*Gallus gallus*). *J Morph* 208:293-309 (1991).
161. AI Caplan. Cell-Mediated Bone Regeneration. In: *Bone-Biomaterials Interface*, Ed. JE Davies, University of Toronto Press, Toronto, Canada, Part III, Chapter 18, pp. 199-204 (1991).
162. AI Caplan. Regenerating Tissues in Adults. In: *Controversies of Total Knee Arthroplasty*, Ed. VM Goldberg, Raven Press, New York, pp. 249-252 (1991).
163. O Nakamura, DJ Fink and AI Caplan. Oriented Collagen Matrices: The Control of Biomineralization in Bone. In: *Materials Synthesis Utilizing Biological Process*, Ed. PC Rieke, Materials Synthesis Society Symposium Proceedings, Pittsburgh, Pennsylvania, 218:275-280 (1991).
164. SE Haynesworth, DA Carrino and AI Caplan. Comparison of the Cartilage Core Protein Synthesized by Chondrocytes of Different Ages. *Conn Tiss Res* 25:311-320 (1991).
165. DA Carrino, JL Arias and AI Caplan. A Spectrophotometric Modification of a Sensitive Densitometric Safranin O Assay for Glycosaminoglycans. *Biochem Intl* 24:485-495 (1991).
166. DP Lennon, DA Carrino, MA Baber and AI Caplan. Generation of a Monoclonal Antibody Against Avian Small Dermatan Sulfate Proteoglycan: Immunolocalization and Tissue Distribution of PG-II (Decorin) in Embryonic Tissues. *Matrix* 11:412-427 (1991).
167. MS Fernandez, JE Dennis, RF Drushel, DA Carrino, K Kimata, M Yamagata and AI Caplan. The Dynamics of Compartmentalization of Embryonic Muscle by Extracellular Matrix Molecules. *Dev Biol* 147:46-61 (1991).

## PUBLICATIONS - Continued

168. H Nakahara, JE Dennis, SP Bruder, SE Haynesworth, DP Lennon and AI Caplan. In Vitro Differentiation of Bone and Hypertrophic Cartilage from Periosteal-Derived Cells. *Exp Cell Res* 195:492-503 (1991).
169. JL Arias, MS Fernandez, JE Dennis and AI Caplan. The Fabrication and Collagenous Substructure of the Eggshell Membrane in the Isthmus of the Hen Oviduct. *Matrix* 11:313-320 (1991).
170. JL Arias, MS Fernandez and AI Caplan. Absence from Avian Eggshell Membranes of Epitopes Recognized by Anti-Keratin Sulfate Antibodies. *Poultry Sci* 70:1647-1650 (1991).
171. J Goshima, VM Goldberg and AI Caplan. Osteogenic Potential of Culture-Expanded Rat Marrow Cells as Assayed In Vivo with Porous Calcium Phosphate Ceramic. *Biomaterials* 12:253-258 (1991).
172. AI Caplan, T Goto, S Wakitani, SJ Pineda, SE Haynesworth and VM Goldberg. Cell-Based Technologies for Cartilage Repair. In: *Biology and Biomechanics of the Traumatized Synovial Joint: The Knee as a Model*, Edited by GAM Finerman and FR Noyes Publisher: American Academy of Orthopaedic Surgeons, Rosemont, IL, pp. 111-122 (1992).
173. J Goshima, VM Goldberg and AI Caplan. The Osteogenic Potential of Culture-Expanded Rat Marrow Mesenchymal Cells Assayed In Vivo in Calcium Phosphate Ceramic Blocks. *Clin Ortho Rel Res* 262:298-311 (1991).

## 1992

174. H Nakahara, VM Goldberg and AI Caplan. Culture-Expanded Periosteal-Derived Cells Exhibit Osteochondrogenic Potential in Porous Calcium Phosphate Ceramics In Vivo. *Clin Ortho Rel Res* 276:291-298 (1992).
175. AH Heuer, DJ Fink, VJ Laraia, JL Arias, PD Calvert, K Kendall, GL Messing, J Blackwell, PC Rieke, DH Thompson, AP Wheeler, A Veis and AI Caplan. Innovative Materials Processing Strategies: A Biomimetic Approach. *Science* 255:1098-1105 (1992).
176. SE Haynesworth, MA Baber and AI Caplan. Cell Surface Antigens on Human Marrow-Derived Mesenchymal Cells are Detected by Monoclonal Antibodies. *Bone* 13:69-80 (1992).
177. SE Haynesworth, J Goshima, VM Goldberg and AI Caplan. Characterization of Cells with Osteogenic Potential from Human Marrow. *Bone* 13:81-88 (1992).
178. S Pineda, A Pollack, S Stevenson, VM Goldberg and AI Caplan. A Semi-quantitative Scale for Histologic Grading of Articular Cartilage Repair. *Acta Anatomica* 143:335-340 (1992).
179. JE Dennis, SE Haynesworth, RG Young and AI. Caplan. Osteogenesis in Marrow-Derived Mesenchymal Cell Porous Ceramic Composites Transplanted Subcutaneously: Effect of Fibronectin and Laminin on Cell Retention and Rate of Osteogenic Expression. *Cell Transpl* 1:23-32 (1992).
180. AI Caplan. Mesenchymal Stem Cell-Mediated Cartilage and Bone Repair. In: *The Biological Mechanisms of Tooth Movement and Craniofacial Adaptation*, Ed. Z Davidovitch, EBSCO Pub., pp. 433-438 (1992).
181. K Nakata, H Nakahara, T Kimura, A Kojima, M Iwasaki, AI Caplan and K Ono. Collagen Gene Expression During Chondrogenesis from Chick Periosteum-Derived Cells. *FEBS Letters* 229(3):278 (1992).
182. JL Arias, DA Carrino, MS Fernandez, JP Rodriguez, JE Dennis and AI Caplan. Partial Biochemical and Immunochemical Characterization of Avian Eggshell Extracellular Matrices. *Arch Biochem Biophys* 298(1):293-302 (1992).
183. DJ Fink, AI Caplan and AH Heuer. Eggshell Mineralization: A Case Study of a Bioprocessing Strategy. *Matls Res Soc Bull* 17(10):27-31 (1992).
184. T-M Wu, DJ Fink, JL Arias, JP Rodriguez, AH Heuer and AI Caplan. The Molecular Control of Avian Eggshell Mineralization. In: *4th International Symposium on Chemistry and Biology of Mineralized Tissues*, San Diego, California, Eds. HC Slavkin and P Price, Excerpta Medica, Amsterdam, pp. 133-142 (1992).
185. LC Gerstenfeld, M Broess, SP Bruder, AI Caplan, and WJ Landis. Regulation of Osteoblast Extracellular Matrix Formation: Post-translational Regulation of Extracellular Matrix Deposition and Relationship

## PUBLICATIONS - Continued

Between Embryonic Development and Hormonal Response. In: *The Chemistry and Biology of Mineralized Tissues*, Eds. H Slavkin and P Price. New York: Elsevier Science, pp. 287-295 (1992).

### 1993

186. JL Arias, DJ Fink, S-Q Xiao, AH Heuer and AI Caplan. Biomineralization and Eggshells: Cell-Mediated Acellular Compartments of Mineralized Extracellular Matrix. *Intl Review Cytol* 145:217-250 (1993).
187. AI Caplan, DJ Fink, T Goto, AE Linton, RG Young, S Wakitani, VM Goldberg and SE Haynesworth. Mesenchymal Stem Cells and Tissue Repair. In: *The Anterior Cruciate Ligament: Current and Future Concepts*, Eds. D Jackson, S Arnoczky, S Woo and C Frank, Raven Press, New York, pp. 405-417 (1993).
188. M Iwasaki, K Nakata, H Nakahara, T Nakase, T Kimura, K Kimata, AI Caplan and K Ono. Transforming Growth Factor- $\beta$ 1 Stimulates Chondrogenesis and Inhibits Osteogenesis in High-Density Culture of Periosteum-Derived Cells. *Endocrinol* 132(4):1603-1608 (1993).
189. JM Sorrell, DA Carrino and AI Caplan. Structural Domains in Chondroitin Sulfate Identified by Anti-Chondroitin Sulfate Monoclonal Antibodies. Immunosequencing of Chondroitin Sulfates. *Matrix* 13:351-361 (1993).
190. JE Dennis and AI Caplan. Porous Ceramic Vehicles for Rat-marrow-derived (*Rattus norvegicus*) Osteogenic Cell Delivery: Effects of Pre-treatment with Fibronectin or Laminin. *J Oral Implant* 19:106-115 (1993).
191. T Nakase, H Nakahara, M Iwasaki, T Kimura, AI Caplan, K Kimata and K Ono. Clonal Analysis for Developmental Potential of Chick Periosteum-Derived Cells: Agar Gel Culture System. *Biochem Biophys Res Commun* 195:1422-1428 (1993).
192. J Vilamitjana-Amedee, R Bareille, F Rouais, AI Caplan, and M-F Harmand. Human Bone Marrow Stromal Cells Express an Osteoblastic Phenotype in Culture. *In Vitro Cell Dev Biol* 29:699-707 (1993).

### 1994

193. SE Haynesworth, VM Goldberg and AI Caplan. Diminution of the Number of Mesenchymal Stem Cells as a Cause for Skeletal Aging. In: *Musculoskeletal Soft-Tissue Aging: Impact on Mobility, Section 1*, Chapter 7, Eds. JA Buckwalter, VM Goldberg, and SL-Y Woo, American Academy of Orthopaedic Surgeons, Publishers (1994) pp. 79-87.
194. DA Carrino, JE Dennis, RF Drushel, SE Haynesworth and AI Caplan. Identity of the Core Proteins of the Large Chondroitin Sulfate Proteoglycans Synthesized by Skeletal Muscle and Prechondrogenic Mesenchyme. *Biochem J* 298: 51-60 (1994).
195. S Wakitani, T Goto, SJ Pineda, RG Young, JM Mansour, VM Goldberg and AI Caplan. Mesenchymal Cell-Based Repair of Large Full-Thickness Defects of Articular Cartilage and Underlying Bone. *J Bone Joint Surg* 76:579-592 (1994).
196. DA Carrino and AI Caplan. The Effect of  $\beta$ -D-Xyloside on the Synthesis of Proteoglycans by Skeletal Muscle: Lack of Effect on Decorin and Differential Polymerization of Core Protein-Bound and Xyloside-Linked Chondroitin Sulfate. *Matrix* 14:121-133, 1994.
197. AI Caplan. The Mesengenic Process. *Clinics in Plastic Surgery* 21: 429-435 (1994).
198. M Iwasaki, H Nakahara, T Nakase, T Kimura, K Takaoka, AI Caplan, and K Ono. Bone Morphogenetic Protein 2 Stimulates Osteogenesis but Does Not Affect Chondrogenesis in Osteochondrogenic Differentiation. *J Bone Miner Res* 9(8):1195-1204 (1994).
199. K Watanabe, SP Bruder and AI Caplan. Transient Expression of Type II Collagen and Tissue Mobilization During Development of the Scleral Ossicle, A Membranous Bone, of the Chick Embryo. *Dev Dynamics* 200: 212-226 (1994).
200. AI Caplan and BD Boyan. Endochondral Bone Formation: The Lineage Cascade, In: *Bone*, Volume 8, Ed. B. Hall, CRC Press, Inc., Boca Raton, Chapter 1, pp. 1-46 (1994).

## PUBLICATIONS - Continued

201. O Nakamura and AI Caplan. Noncollagenous Matrix Protein-Enhanced Mineral Deposition in Osteoblast-Like Cell Culture. *J Bone Miner Met* 12:17-25 (1994).
202. SP Bruder, DJ Fink and AI Caplan. Mesenchymal Stem Cells in Bone Development, Bone Repair, and Skeletal Regeneration. *J Cell Biochem* 56:283-294 (1994).
203. VM Goldberg and AI Caplan. Evolving Technologies: Old Problems and New Answers. Biological Resurfacing: An Alternative to Total Joint Arthroplasty *Orthopaed* 17(9): 819-821 (1994).
204. M Liebergall, RG Young, N Ozawa, JH Reese, DT Davy, VM Goldberg and AI Caplan. The Effects of Cellular Manipulation and TGF- $\beta$  in a Composite Graft. In: *Bone Formation and Repair*, Ed. CT Brighton, GE Friedlaender, and JM Lane, American Academy of Orthopaedic Surgeons Symposium, November 13-16, 1993, Tampa, Florida, Section 4, Chapter 26, pp. 367-378 (1994).
205. T-M Wu, JP Rodriguez, DJ Fink, DA Carrino, J Blackwell, AI Caplan, and AH Heuer. Crystallization Studies on Avian Eggshell Membranes: Implications for the Molecular Factors Controlling Eggshell Formation. *Matrix Biol* 14: 507-513 (1994).

## 1995

206. DP Lennon, SE Haynesworth, RG Young, JE Dennis and AI Caplan. A Chemically Defined Medium Supports Proliferation and Maintains Osteochondrogenic Potential of Rat Marrow-Derived Mesenchymal Stem Cells. *Exp Cell Res* 219: 211-222 (1995).
207. VM Goldberg and AI Caplan. Cellular Repair of Articular Cartilage. In: *Osteoarthritic Disorders*, Ed., KE Keuttner and VM Goldberg, American Academy of Orthopaedic Surgeons Symposium, New Horizons in Osteoarthritis, April 1995. Rosemont, Illinois, Chapter 25, pp. 357-363 (1995).
208. HM Lazarus, SE Haynesworth, SL Gerson, N Rosenthal, and AI Caplan. *Ex-Vivo* Expansion and Subsequent Infusion of Human Bone Marrow-Derived Stromal Progenitor Cells (Mesenchymal Progenitor Cells) [MPCs]: Implications for Therapeutic Use. *Bone Marrow Transpl* 16:557-564 (1995).
209. S Wakitani, T Saito and AI Caplan. Myogenic Cells Derived from Rat Bone Marrow Mesenchymal Stem Cells Exposed to 5-Azacytidine. *Muscle & Nerve* 18:1417-1426 (1995).
210. AI Caplan. *Osteogenesis Imperfecta*, Rehabilitation Medicine and Fundamental Research. *Conn Tissue Res* 31:S9-S14 (1995).

## 1996

211. T Saito, JE Dennis, DP Lennon, RG Young and AI Caplan. Myogenic Expression of Mesenchymal Stem Cells within Myotubes of *mdx* Mice In Vitro and In Vivo. *Tissue Eng* 1:327-344 (1996).
212. AI Caplan and SP Bruder. Cell and Molecular Engineering of Bone Regeneration. In: *Principles of Tissue Engineering*, Ed., RP Lanza, WL Chick, and R Langer. RG Landes Co. (Springer, NY) pp. 599-618 (1996).
213. JM Sorrell, MA Baber and AI Caplan. Construction of a Bi-Layered Dermal Equivalent Containing Human Papillary and Reticular Dermal Fibroblasts: Use of Fluorescent Vital dyes. *Tissue Eng* 2:39-50 (1996).
214. P Cassiede, JE Dennis, F Ma, and AI Caplan. Osteochondrogenic Potential of Marrow Mesenchymal Progenitor Cells Exposed to TGF- $\beta$ 1 or PDGF-BB As Assayed In Vivo and In Vitro. *J Bone Min Res* 11:1264-1273 (1996).
215. JE Dennis, S-Q Xiao, M Agarwal, DJ Fink, AH Heuer, and AI Caplan. Microstructure of the Matrix and Mineral Components of Avian Eggshells. *J Morphol* 228:287-306 (1996).
216. SE Haynesworth, MA Baber and AI Caplan. Cytokine Expression by Human Marrow-Derived Mesenchymal Progenitor Cells In Vitro: Effects of Dexamethasone and IL-1 $\alpha$ . *J Cell Physiol* 166:585-592 (1996).
217. DP Lennon, SE Haynesworth, SP Bruder, N Jaiswall and AI Caplan. Human and Animal Mesenchymal Progenitor Cells from Bone Marrow: Identification of Serum for Optimal Selection and Proliferation. *Vitro Cell Develop Bio* 32:602-611, (1996).

## PUBLICATIONS - Continued

218. JM Sorrell, DA Carrino and AI Caplan. Regulated Expression of Chondroitin Sulfates at Sites of Epithelial-Mesenchymal Interaction: Spatio-Temporal Patterning Identified with Anti-Chondroitin Sulfate Monoclonal Antibodies. *Int J Devel Neurosci* 14:233-248, (1996).
219. AI Caplan and JE Dennis. Mesenchymal Stem Cells: Progenitors, Progeny and Pathways. *J Bone Min Metab* 14:193-201 (1996).
220. LM Mann, DP Lennon, and AI Caplan. Cultured Rat Pulp Cells Have the Potential to Form Bone, Cartilage, and Dentin In Vivo. In: *Biological Mechanisms of Tooth Movement & Craniofacial Adaptation*. Z Davidovitch and LA Norton, eds., Harvard Society for the Advancement of Orthodontics, Publishers. Printed by EBSCO Media, Birmingham, AL., pp. 7-16 (1996).
221. JE Dennis and AI Caplan. Differentiation Potential of Conditionally Immortalized Mesenchymal Progenitor Cells from Adult Marrow of a H-2K<sup>b</sup>-tsA58 Transgenic Mouse. *J Cell Physiol* 167:523-538, (1996).
222. LC Gerstenfeld, DJ Zurakowski, JL Schaffer, DP Nichols, CD Toma, M Broess, SP Bruder, and AI Caplan. Variable Hormone Responsiveness of Osteoblast Populations Isolated at Different Stages of Embryogenesis and its Relationship to the Osteogenic Lineage. *Endocrinology* 137:3957-3968, (1996).

## 1997

223. DA Carrino, JE Dennis, T-M Wu, JL Arias, MS Fernandez, JP Rodriguez, DJ Fink, AH Heuer, and AI Caplan. The Avian Eggshell Extracellular Matrix as a Model for Biomineralization. *Conn Tissue Res* 35:325-329, (1997).
224. JE Dennis and AI Caplan. Analysis of the Developmental Potential of Conditionally Immortal Marrow-Derived Mesenchymal Progenitor Cells Isolated from the H-2K<sup>b</sup>-tsA58 Transgenic Mouse. *Conn Tissue Res* 35:93-99, (1997).
225. N Jaiswal, SE Haynesworth, AI Caplan, and SP Bruder. Osteogenic Differentiation of Purified, Culture-Expanded Human Mesenchymal Stem Cells In Vitro. *J Cell Biochem* 64:295-312 (1997).
226. JL Arias, O Nakamura, MS Fernandez, T-M Wu, P Knigge, DR Eyre and AI Caplan. Role of Type X Collagen on Experimental Mineralization of Eggshell Membranes. *Conn Tiss Res* 36:21-33 (1997).
227. K Hanada, JE Dennis, and AI Caplan. Stimulatory Effects of Basic Fibroblast Growth Factor (bFGF) and Bone Morphogenetic Protein-2 (BMP-2) on Osteogenic Differentiation of Rat Bone Marrow-Derived, Mesenchymal Stem Cells (MSCs). *J Bone and Min Res* 12:1606-1614(1997).
228. AI Caplan, M Elyaderani, Y Mochizuki, S Wakitani, and VM Goldberg. The Principles of Cartilage Repair/Regeneration. *Clin Orth Rel Res* 342:254-269 (1997).
229. JA Allay, JE Dennis, SE Haynesworth, M Majumdar, DW Clapp, AI Caplan and SL Gerson. LacZ and IL-3 Expression In Vivo After Retroviral Transduction of Marrow-Derived Human Osteogenic Mesenchymal Progenitors. *Human Gene Therapy* 8:1417-1427 (1997).

## 1998

230. HM Lazarus, MA Thiede, SE Haynesworth, SL Gerson and AI Caplan. Human Bone Marrow-Derived Mesenchymal Progenitor Cells (MPCs) Cannot Be Recovered From Peripheral Blood Progenitor Cell Collections. *J Hematotherapy* 6:447-455 (1998).
231. LA Solchaga, P Cassiede, and AI Caplan. Different Response to Osteo-Inductive Agents in Bone Marrow- and Periosteum-Derived Cell Preparations. *Acta Scandia Ortho* 69: 426-432 (1998).
232. AI Caplan, DJ Fink, SP Bruder, RG Young and DL Butler. The Regeneration of Skeletal Tissues Using Mesenchymal Stem Cells. In: *Frontiers in Tissue Engineering* Eds. CW Patrick Jr., AG Mikos and LV McIntire, Elsevier Science, New York, Chapter III.7, Pages 471-480 (1998).
233. B Johnstone, TM Hering, VM Goldberg, JU Yoo, and AI Caplan. In Vitro Chondrogenesis of Bone Marrow-Derived Mesenchymal Progenitor Cells. *Exp Cell Res* 238:265-272 (1998).

## **PUBLICATIONS - Continued**

234. JE Fleming, Jr., P Cassiede, M Baber, SE Haynesworth and AI Caplan. A Monoclonal Antibody Against Adult Marrow-Derived Mesenchymal Cells Recognizes Developing Vasculature in Embryonic Human Skin. *Dev Dyn* 212:119-132 (1998).
235. RG Young, DL Butler, W Weber, SL Gordon, DJ Fink, and AI Caplan. The Use of Mesenchymal Stem Cells in Achilles Tendon Repair. *J Orthop Res* 16:406-413 (1998).
236. S Kawamura, S Wakitani, A Maeda, AI Caplan, T Kimura, K Shino, and T Ochi. Articular Cartilage Repair. Rabbit Experiments with a Collagen Gel-Biomatrix and Chondrocytes Cultured Within It. *Acta Orthop Scand* 69:56-62 (1998).
237. JE Dennis, EK Konstantakos, D Arm, and AI Caplan. In Vivo Osteogenesis Assay: A Rapid Method for Quantitative Analysis. *Biomaterials* 19:1323-1328 (1998).
238. DA Carrino, JP Rodriguez, and AI Caplan. Dermatan Sulfate Proteoglycans from the Mineralized Matrix of the Avian Eggshell. *Conn Tiss Res* 36:175-193 (1998).
239. S Wakitani, T Goto, RG Young, JM Mansour, VM Goldberg and AI Caplan. The Repair of Large Full-Thickness Weight-Bearing Articular Cartilage Defects with Allograft Articular Chondrocytes Embedded in a Collagen Gel. *Tissue Eng* 4:429-442 (1998).
240. JU Yoo, TS Barthel, K Nishimura, LA Solchaga, AI Caplan, VM Goldberg, and B Johnstone. The Chondrogenic Potential of Human Bone-Marrow-Derived Mesenchymal Progenitor Cells. *J Bone and Joint Surg* 80:1745-1757 (1998).

## **1999**

241. SE Haynesworth, D Reuben and AI Caplan. Cell-based Tissue Engineering Therapies: The Influence of Whole Body Physiology. *Adv Drug Delivery Rev* 33:3-14 (1999).
242. BD Boyan, AI Caplan, JD Heckman, DP Lennon, W Ehler, and Z Schwart Osteochondral Progenitor Cells in Acute and Chronic Canine Nonunions. *J Orthop Res* 17:246-255 (1999).
243. VM Goldberg, LA Solchaga, J Yoo, B Johnstone and AI Caplan. Chondroprogenitor Cell Repair of Full Thickness Defects of Articular Cartilage. *J Sports Traumatol* 20: 81-89 (1999).
244. H Ohgushi and AI Caplan. Stem Cell Technology and Bioceramics: From Cell to Gene Eng. *J Biomed Mat Res* 48:1-15, 1999.
245. LA Solchaga, JE Dennis, VM Goldberg and AI Caplan. Hyaluronic Acid-Based Polymers as Cell Carriers for Tissue Engineered Repair of Bone and Cartilage. *J Orthop Res* 17:205-213 (1999).
246. H Awad, DL Butler, P Malaviag, GP Boivin, FNL Smith, B Huibregste, and AI Caplan. Autologous Mesenchymal Stem Cell-Mediated Repair of Tendon. *Tissue Eng* 5 (3): 267-277 (1999).
247. JM Sorrell, DA Carrino, MA Baber, D Asselineau and AI Caplan. A Monoclonal Antibody PG-4 Recognizes a Glycosaminoglycan Epitope Found on both Dermatan Sulfate and Chondroitin Sulfate Proteoglycans in Human Skin. *Histochem J* 31:549-558 (1999).
248. DA Carrino, JM Sorrell and AI Caplan. Dynamic Expression of Proteoglycans During Chicken Skeletal Muscle Development and Maturation. *J Poult Sci* 78:769-777 (1999).
249. JM Sorrell, DA Carrino, MA Baber and AI Caplan. Versican in Human Fetal Skin Development. *Anat Embryol* 199:45-56 (1999).
250. LA Solchaga, B Johnstone, JU Yoo, VM Goldberg and AI Caplan. High Variability in Rabbit Bone Marrow-Derived Mesenchymal Progenitor Cell Preparations. *Cell Transplant* 8:511-519 (1999).
251. CJ Walsh, D Goodman, AI Caplan and VM Goldberg. Meniscus Regeneration in a Rabbit Partial Meniscectomy Model. *Tissue Eng* 5:327-337. (1999).
252. VM Goldberg and AI Caplan. Biological Restoration of Articular Surfaces. *Instr Course Lect* 48:623-628 (1999) [AAOS, Rosement, IL].
253. K Nishimura, LA Solchaga, AI Caplan, JU Yoo, VM Goldberg and B Johnstone. Chondroprogenitor Cells of Synovial Tissue. *Arthritis Rheum* 42:2631-7 (1999).
254. VM Goldberg, LA Solchaga, M Lundberg, J Yoo, B Johnstone, B Huibregtse, AI Caplan. Regenerative Cell-based Repair of Osteochondral Defects of Articular Cartilage. *Semin Arthrop* 10:30-36, (1999).

## PUBLICATIONS - Continued

255. JE Dennis, A Meriam, A Awadallah, J Yoo, B Johnstone and AI Caplan. A Quadripotential Mesenchymal Progenitor Cell Isolated from the Marrow of an Adult Mouse. *J Bone & Min Res* 14:1-10, (1999).
256. AI Caplan and VM Goldberg. The Principles of Tissue Engineered Regeneration of Skeletal Tissues. *Clin Orthop Rel Res* 367S:S12-S16 (1999).
257. O Nakamura, DJ Fink, DP Lennon, VL Laraia, AH Heuer, and AI Caplan. Matrix-Directed *In Vitro* Osteogenesis. *Bioceramics* 12:249-252 (1999).
258. ON Koc, C Peters, P Aubourg, S Raghavan, S Dyhouse, R DeGasperi, EH Kolodny, YB Yoseph, SL Gerson, HM Lazarus, AI Caplan, P Watkins, and W Krivit. Bone Marrow Derived Mesenchymal Stem Cells Remain Host-Derived Despite Successful Hematopoietic Engraftment after Allogeneic Transplantation in Patients with Lysosomal and Peroxisomal Storage Diseases. *Exp Hemtcol* 27:1675-1681 (1999).
259. AI Caplan. Tissue Engineering Strategies for Mesenchymal or Skeletal Tissues. In: *Tissue Eng for Therapeutic Use 4: Proceedings of the 4<sup>th</sup> Intl Symp on Tiss Eng*, Eds. Y Ikada and Y Shimizu Elsevier Science, BV: Kyoto, Japan, September, 1999, pp 67-72.
260. AI Caplan and JE Dennis. Commentary: Genetically Linked Scientists: The One-Two Punch for NFATp Knockout. *J Exp Med* 191:1-3 (1999).

## 2000

261. LA Solchaga, JU Yoo, M Lundberg, JE Dennis, BA Huibregtse, VM Goldberg and AI Caplan. Hyaluronic Acid-Based Polymers in the Treatment of Osteochondral Defects. *J Orthop Res* 18:773-780, (2000).
262. BA Huibregtse, B Johnstone, and AI Caplan. The Effect of Age and Sampling Site on the Chondro-Osteogenic Potential of Rabbit Marrow-derived Mesenchymal Progenitor Cells *J Orthop Res* 18:18-24 (2000).
263. ON Koc, SL Gerson, BW Cooper, SM Dyhouse, SE Haynesworth, AI Caplan, N Tainer, and HM Lazarus. Rapid Hematopoietic Recovery After Co-Infusion of Autologous Blood Stem Cells and Culture Expanded Marrow Mesenchymal Stem Cells in Advanced Breast Cancer Patients Receiving High Dose Chemotherapy. *J Clin Oncology* 18:307-316 (2000).
264. M Richards, BA Huibregtse, AI Caplan, JA Goulet and SA Goldstein. Marrow-Derived Progenitor Cell Injections Enhance Bone Regeneration During Distraction. *J Orthop Res* 17:900-908 (2000).
265. SP Bruder and AI Caplan. Bone Regeneration through Cellular Engineering. In: *Principles in Tissue Engineering, 2<sup>nd</sup> Edition*, Chapter 48, Eds. R Lanza, R Langer and J Vancanti, Springer, New York (2000) pp. 683-696.
266. LA Solchaga, VM Goldberg, and AI Caplan. Hyaluronic Acid Based Biomaterials in Tissue Engineered Cartilage Repair. In: *New Frontiers in Medical Sciences: Redefining Hyaluronan*, Eds. G Abantangelo and PH Weigel, Elsevier Science, (2000) pp. 233-246.
267. DP Lennon, SE Haynesworth, DM Arm, MA Baber and AI Caplan. Dilution of Human Mesenchymal Stem Cells with Dermal Fibroblasts and the Effects on *In Vitro* and *In Vivo* Osteogenesis. *Devel Dynamics* 219:50-62 (2000).
268. AI Caplan. Tissue Engineering Designs for the Future: New Logics, Old Molecules. *Tiss Eng* 6:1-8 (2000).
269. DA Carrino, JM Sorrell and AI Caplan. Age-related Changes in the Proteoglycans of Human Skin. *Archives of Biochemistry and Biophysics*, 373:91-101 (2000).
270. AI Caplan. Mesenchymal Stem Cells and Gene Therapy. *Clin Ortho & Rel Res* 379S:67-70 (2000).
271. JM Sorrell, DA Carrino, and AI Caplan. In: *Core Proteins*. Eds. Developmental and Aging Changes of Chondroitin/Dermatan Sulfate Proteoglycans. Chapter 44, Pp. 729-742, (2000).

## PUBLICATIONS - Continued

### 2001

272. AI Caplan and SP Bruder. Mesenchymal Stem Cells: Building Blocks for Molecular Medicine in the 21<sup>st</sup> Century. *Trends in Molecular Medicine* 6:259-264 (2001).
273. J Gao, JE Dennis, RF Muzic, M Lundberg and AI Caplan. The Dynamic *In Vivo* Distribution of Bone Marrow-Derived Mesenchymal Stem Cells after Infusion. *Cells Tissues Organs* 169:12-20 (2001).
274. JE Dennis, DA Carrino, K Yamashita, and AI Caplan. Monoclonal Antibodies to Mineralized Matrix Molecules of the Avian Eggshell. *Matrix Biol* 19:683-692 (2001).
275. DP Lennon, J Edmison, and AI Caplan. Cultivation of Rat Marrow-Derived Mesenchymal Stem Cells in Reduced Oxygen Tension: Effects on *In Vitro* and *In Vivo* Osteochondrogenesis. *J Cell Physiol*. 187:345-355 (2001).
276. J Gao, JE Dennis, LA Solchaga, A Awadallah, VM Goldberg and AI Caplan. Tissue Engineered Fabrication of an Osteochondral Composite Graft Using Rat Bone Marrow-Derived Mesenchymal Stem Cells. *Tiss Eng* 7:363-371 (2001).
277. LA Solchaga, VM Goldberg, and AI Caplan. Cartilage Regeneration Using Principles of Tissue Engineering. *Clin Orthop Suppl* 391:S161-S170 (2001).
278. K Hanada, LA Solchaga, AI Caplan, TM Hering, VM Goldberg, JU Yoo, B Johnstone. BMP-2 induction and TGF-beta 1 modulation of rat periosteal cell chondrogenesis *J.Cell Biochem* 81, 284-294 (2001).

### 2002

279. JE Dennis, J-P Carbillet, AI Caplan and P Charbord. The STRO-1+ Marrow Cell Population is Multi-Potential. *Cells Tissues Organs* 170:73-82 (2002).
280. AI Caplan. Physiological Changes: Mesenchymal Stem Cells. In: *Macmillan Encyclopedia of Aging*. DJ Ekerdt Ed. 1<sup>st</sup> Edition, August (2002).
281. LA Solchaga, J Gao, JE Dennis, A Awadallah, M Lundberg, AI Caplan, VM Goldberg. Treatment of Osteochondral Defects with Autologous Bone Marrow in a Hyaluronan-Based Delivery Vehicle. *Tiss Eng* 8:333-347 (2002).
282. J Gao, JE Dennis, LA Solchaga, VM Goldberg, and AI Caplan. Repair of Osteochondral Defect with Tissue Engineered Two-phase Composite Material of Injectable Calcium Phosphate and Hyaluronan Sponge. *Tissue Eng* 8:827-837 (2002).
283. A Naumann, JE Dennis, A Awadallah, DA Carrino, JM Mansour, E Kastenbauer, AI Caplan, Immunochemical and Mechanical Characterization of Cartilage Subtypes in Rabbit *Journal of Histochemistry & Cytochemistry* 50(8):1049-1058 (2002).
284. AI Caplan. *In Vivo* Remodeling” In: *Reparative Medicine: Growing Tissues and Organs*, Ann. NY Acad Sci, 961:307-309 (2002).
285. MS Wolfe, D Dean, JE Chen, JP Fisher, C Rinnac, AI Caplan, M N Cooke, LA Solchaga, S Han, and AG Mikos *In Vitro* Degradation and Fracture Toughness of Multilayered Porous Poly(Propylene Fumerate)/β-Tricalcium Phosphate Scaffolds *Ann. N.Y. Acad Sci* 961: 1-8 (2002).
286. MO Pei, LA Solchaga, J Seidel, L Zeng. G Vunjak-Novakovic, AI Caplan, LE Freed, Bioreactors mediate the effectiveness of tissue engineering scaffolds, *FASEB*, 16:1691-4, (2002).

### 2003

287. A Naumann, JE Dennis, R Staudenmaier, N Rotter, J Aigner, B Ziegelaar, T Happ, G Rasp, AI Caplan, Mesenchymal Stem Cells – A New Pathway for Tissue Engineering in Reconstructive Surgery. *Laryngo Rhino Otol* 81:521-527 (2003).
288. LA Solchaga, JF Welter, AI Caplan, VM Goldberg. Cartilage tissue engineering. In: *The Adult Knee*, JJ Callaghan, AG Rosenberg, HE Rubash, PT Simonian and TA Wickiewicz, Eds. Lippincott Williams & Wilkins, Philadelphia, PA, Chapter 18, 251-258, 2003.

## PUBLICATIONS - Continued

289. AI Caplan. Design Parameters For Functional Tissue Engineering In: *Functional Tissue Engineering*, F Guilak, DL Butler, SA Goldstein, DJ Mooney, Eds. Springer-Verlag, New York, Chapter 10, pp. 129-138, 2003.
  290. AI Caplan Embryonic Development and the Principles of Tissue Engineering In: *Novartis Foundation: Tissue Engineering of Cartilage and Bone*, John Wiley & Sons Ltd., London, England. 249, 17-33, 2003.
  291. JM Sorrell, MB Seavolt, M Baber, DA Carrino, D Asselineau, AI Caplan, Production of a Monoclonal Antibody, DF-5, that Identifies Cells at the Epithelial/Mesenchymal Interface in Normal Human Skin. APN/CD13 is an Epithelial/Mesenchymal Marker in Skin. *Exp Derm* 12:315-323 (2003).
  292. LA Solchaga, VM Goldberg and AI Caplan. Hyaluronan and Tissue Engineering. In: *Hyaluronan* eds. JF Kennedy, GO Phillips, PA Williams and VC Hascall. Woodhead Pub. Limited, Cambridge, England, Vol. 2, pp. 45-54 (2003).
  293. DA Carrino, P Önerfjord, J Sandy, G Cs-Szabo, P Scott, JM Sorrell, D Heinegård, AI Caplan, Age-related changes in the proteoglycans of human skin: Specific cleavage of decorin to yield a major catabolic fragment in adult skin, *Journal of Biological Chemistry* 278: 19:17566-17572 (2003).
  294. LA Solchaga, VM Goldberg and AI Caplan. Cartilage Repair with Bone Marrow in a Hyaluronan-Based Scaffold. In: *Hyaluronan* eds. JF Kennedy, GO Phillips, PA Williams and VC Hascall. Woodhead Pub. Limited, Cambridge, England, Vol. 2, pp. 63-66 (2003).
  295. JE Dennis, LA Solchaga, AI Caplan, Book Chapter: Chapter 10. Human Mesenchymal Stem Cells for Cartilage Repair. In: *Mesenchymal stem cells: biology and potential clinical uses*, pp 157-168. Ed by S Grisolia, MD Miñana and EB Bendala-Tufanisco. Madrid, Spain, Ministerio De Sanidad Y Consumo, 2003.
  296. LA Solchaga and AI Caplan. Potential Use of a Novel Hyaluronan-Based Delivery Vehicle in Bone Regeneration. In: *Hyaluronan* eds. JF Kennedy, GO Phillips, PA Williams and VC Hascall. Woodhead Pub. Limited, Cambridge, England, Vol. 2, pp. 67-70 (2003).
  297. JM Sorrell, L Brinon, MA Baber, AI Caplan, Cytokines and glucocorticoids differentially regulate APN/CD13 and DPPIV/CD26 enzyme activities in cultured human dermal fibroblasts. *Arch Dermatol Res* 295:160-168 (2003).
  298. T Tallheden, JE Dennis, DP Lennon, E Sjogren-Jansson, AI Caplan, A Lindahl. Phenotypic plasticity of human articular chondrocytes. *J Bone Joint Surg* 85-A Suppl 2:93-100. (2003).
  299. J Gao, AI Caplan. Mesenchymal Stem Cells and Tissue Engineering for orthopaedic surgery. *Chir Organi Mov* 88:305-316, (2003).
  300. K Yamashita, JE Dennis, DP Lennon, H Morimoto, S Kitamura, AI Caplan. Dental Pulp Cells with Multi-Potential for Differentiation to Odontoblast and Chondroblast. *J Hard Tiss Biol* 12:49-55, 2003.
- 2004**
301. A Alhadlaq, J Elisseff, L Hong, C Williams, AI Caplan, B Sharma, R Kopher, S Tomkoria, DP Lennon, A Lopez, J Mao. Adult stem cell driven genesis of human-shaped articular condyle. *Annals of Biomedical Engineering* 32:911-923, 2004.
  302. JM Sorrell and AI Caplan. Fibroblast heterogeneity: more than skin deep. *J Cell Sci* 117, 667-675, 2004.
  303. JE Dennis, N Cohen, VM Goldberg, AI Caplan. Targeted Delivery of Progenitor Cells for Cartilage Repair. *J Orthop Res* 22:735-741, 2004.
  304. VM Goldberg and AI Caplan. Principles of Tissue Engineering and Regeneration of Skeletal Tissues, In: *Orthopedic Tissue Engineering Basic Science and Practice*. Eds. VM Goldberg, AI Caplan, Marcel Dekker, Inc. New York, NY, Chapter 1, pp. 1-9, 2004.
  305. JM Sorrell, MA Baber, D Asselineau, AI Caplan. Site-matched papillary and reticular human dermal fibroblasts differ in their production of specific growth factors/cytokines and in their interaction with keratinocytes. *J Cell Phys* 200:134-145 (2004).
  306. K Derwin, C Androjna, E Spencer, O Safran, TW Bauer, T Hunt, J Iannotti, AI Caplan. Porcine small intestine submucosa (SIS) as a flexor tendon graft. *Clin Ortho and Rel Res* 423:245-252, 2004.

## **PUBLICATIONS - Continued**

307. JE Dennis, and AI Caplan. Bone Marrow Mesenchymal Stem Cells, *In: Stem Cells Handbook*, S Sell ed., Humana Press, Totowa, NJ, pp. 108-118 (2004).
308. G Kogler, S Sensken, JA Airey, T Trapp, M Muschen, N Feldhahn, S Liedtke, RV Sorg, J Fischer, C Rosenbaum, S Greschat, A Knipper, J Bender, O Degistirici, J Gao, AI Caplan, EJ Colletti, G Almeida-Porada, HW Muller, E Zanjani, P Wernet. A new human somatic stem cell from placental cord blood with intrinsic pluripotent differentiation potential. *J Exp Med* 200:123-35, 2004.
309. J Gao, D Knaack, VM Goldberg, AI Caplan. Osteochondral Defect Repair by Demineralized Cortical Bone Matrix. *Clin Ortho* 427:62-66, 2004.
310. JE Dennis, AI Caplan. Advances in mesenchymal stem biology. *Curr Opin Orthop* 15:341-346, 2004.
311. EL Hedberg, CK Shih, LA Solchaga, AI Caplan, AG Mikos. Controlled release of hyaluronan oligomers from biodegradable polymeric microparticle carriers. *J Con Rel* 100:257-266, 2004.
312. A Naumann, JE Dennis, J Aigner, J Coticchia, J Arnold, A Berghaus, ER Kastenbauer, AI Caplan. Tissue Engineering of Autologous Cartilage Grafts in Three-Dimensional in Vitro Macroaggregate Culture System. *Tiss Eng* 10:1695-1706, 2004.
313. LA Solchaga, JF Welter, DP Lennon, AI Caplan. Generation of Pluripotent Stem Cells and Their Differentiation to the Chondrocytic Phenotype, *In: Cartilage and Osteoarthritis Volume 1 Cellular and Molecular Tools*, M Sabatini, P Pastoureau, FD Ceuninck eds., The Humana Press, Totowa, NJ, pp. 53-67, 2004.
314. AI Caplan. Mesenchymal Stem Cells, *In: Handbook of Stem Cells, Vol 2*, Academic Press, pp. 299-308, 2004.

## **2005**

315. K Nishioka, JE Dennis, J Gao, VM Goldberg, AI Caplan. Sustained Wnt Protein Expression in Chondral Constructs From Mesenchymal Stem Cells. *J Cell Phys* 203:6-14, 2005.
316. LA Solchaga, K Penick, JD Porter, VM Goldberg, AI Caplan, JF Welter. FGF-2 Enhances the Mitotic and Chondrogenic Potentials of Human Adult Bone Marrow-Derived Mesenchymal Stem Cells. *J Cell Physiol, J Cell. Physiol* 203:398-409, 2005.
317. LA Solchaga, JS Temenoff, J Gao, AG Mikos, AI Caplan, VM Goldberg. Repair of osteochondral defects with hyaluronan- and polyester-based scaffolds. *OsteoArthritis and Cartilage* 13:297-209, 2005.
318. D Dean, MS Wolfe, Y Ahmad, A Totonchi, JE-K Chen, JP Fisher, MN Cooke, CM Rimnac, DP Lennon, AI Caplan, NS Topham, AG Mikos. The Effect of TGF- $\beta$ 2 on Marrow-infused-foam Poly(Propylene Fumarate) Tissue Engineered Constructs for the Repair of a Critical Size Cranial Defect in the Rabbit. *Tiss Eng* 11:923-939, 2005.
319. AI Caplan. Mesenchymal Stem Cell: Cell-Based Reconstructive Therapy in Orthopaedics. *Tiss Eng* 11:1198-1211, 2005.
320. AI Caplan. Mesenchymal Stem Cells, *In: Essentials of Stem Cell Biology*, R Lanza, J Gearhart, B Hogan, D Melton, R Pedersen, ED Thomas, J Thomason, M West eds., Elsevier Academic Press, Ch. 27, pp. 205-210, 2005.

## **2006**

321. DP Lennon and AI Caplan. Mesenchymal Stem Cells for Tissue Engineering, *In: Culture of Cells for Tissue Engineering*, G Vunjak-Novakovic, RI Freshney eds., John Wiley & Sons, Inc., Ch. 1, pp. 23-59, 2006.
322. AI Caplan and JE Dennis. Mesenchymal Stem Cells as Trophic Mediators. *J Cell Biochem*, 98:1076-1084, 2006.
323. AI Caplan. Fundamentals of Stem Cell Tissue Engineering, *In: Tissue Engineering and Artificial Organs*, JD Bronzino ed, Taylor and Francis Group CRC Press, Ch. 30, pp. 1-10, 2006.

## **PUBLICATIONS - Continued**

324. G Lisignoli, S Cristino, A Piacentini, C Cavallo, AI Caplan, A Facchini. Hyaluronan-based polymer scaffold modulates the expression of inflammatory and degradative factors in mesenchymal stem cells: Involvement of CD44 and CD54. *J Cell Physiol* 207:364-373, 2006.
325. Y Chang, VM Goldberg, AI Caplan. Toxic Effects of Gentamicin on Marrow-derived human mesenchymal stem cells. *Clin Ortho Rel Res* 452:242-249, 2006.
326. DP Lennon, AI Caplan. Isolation of human marrow-derived mesenchymal stem cells. *Exp Hema* 34:1604-1605, 2006.
327. DP Lennon, AI Caplan. Isolation of rat-marrow-derived mesenchymal stem cells. *Exp Hema* 34:1606-1607, 2006.
328. I Kerkis, A Kerkis, D Dozortsev, GC Stukart-Parsons, SMG Massironi, LV Pereira, AI Caplan, HF Cerruti. Isolation and characterization of a population of immature dental pulp stem cells expressing OCT-4 and other embryonic stem cell markers. *Cells Tissues Organs* 184:105-116, 2006.

## **2007**

329. JM Sorrell, MA Baber, AI Caplan. Clonal characterization of fibroblasts in the superficial layer of the adult dermis. *Cell and Tissue Research*, 327:499-510, 2007.
330. L Bai, AI Caplan, DL Lennon, RH Miller. Human mesenchymal stem cells signals regulate neural stem cell fate. *Neurochem Res*, 32:353-362, 2007.
331. H Park, JS Temenoff, Y Tabata, AI Caplan, AG Mikos. Injectable biodegradable hydrogel composites for rabbit marrow mesenchymal stem cell and growth factor delivery for cartilage tissue engineering. *Biomaterials*, 28:3217-3227, 2007.
332. JH Henderson, JF Welter, JM Mansour, C Niyibizi, AI Caplan, JE Dennis. Cartilage tissue engineering for pediatric laryngotracheal reconstruction: comparison of chondrocyte from three anatomic locations in the rabbit. *Tiss Eng*, 13:843-853, 2007.
333. J Gao, JQ Yao, AI Caplan. Stem cells for tissue engineering of articular cartilage. *Proc. IMechE*, 221:441-450, 2007.
334. AI Caplan. Adult mesenchymal stem cells for tissue engineering versus regenerative medicine. *J. Cell Physiol*, 213:341-347, 2007.
335. JM Sorrell, MA Baber, AI Caplan. A self-assembled fibroblast-endothelial cell co-culture system that supports in vitro vasculogenesis by both human umbilical vein endothelial cells and human dermal microvascular endothelial cells. *Cells Tissues Organs*, 186:157-168, 2007.

## **2008**

336. JM Sorrell, MA Baber, AI Caplan. Human dermal fibroblast subpopulations; differential interactions with vascular endothelial cells in coculture: Nonsoluble factors in the extracellular matrix influence interactions. *Wound Rep Reg*, 16:300-309, 2008.
337. DL Butler, JL Lewis, CB Frank, AJ Banes, AI Caplan, PG De Deyne, et al. Evaluation criteria for musculoskeletal and craniofacial tissue engineering constructs: A conference report. *Tiss Eng, Part A* 14:2089-2104, 2008.
338. WL Grayson, S Bhumiratana, C Canizarro, PG Chao, DP Lennon, AI Caplan, G Vunjak-Novakovic. Effects of initial seeding density and fluid perfusion rate on formation of tissue-engineered bone. *Tiss Eng, Part A*: 14:1809-1820, 2008.
339. L da Silva Meirelles, AI Caplan, NB Nardi. In search of the in vivo identity of mesenchymal stem cells. *Stem Cells*. *Stem Cells* 26:2287-2299, 2008.
340. AI Caplan. All MSCs are pericytes? *Cell Stem Cell*, 3:229-30, 2008.

## PUBLICATIONS - Continued

### 2009

341. TL Bonfield, M Koloze, D Lennon, B Zuchowski, SE Yang, AI Caplan. Human mesenchymal stem cells suppress chronic airway inflammation in the murine ovalbumin asthma model. *Am J Physiology Lung*. In Revision, 2009.
342. AI Caplan. New era of cell-based orthopaedic therapies. *Tissue Eng Part B*, 15(2):195-200, 2009.
343. L Bai, DP Lennon, V Eaton, K Maier, AI Caplan, SD Miller and RH Miller. Human bone marrow-derived mesenchymal stem cells induce Th2-polarized immune response and promote endogenous repair in animal models of multiple sclerosis. *Glia*, 57:1192-203, 2009.
344. AI Caplan. Why are MSCs therapeutic? New data: new insight. *J Pathol*, 217:318-324, 2009.
345. JM Sorrell, MA Baber and AI Caplan. Influence of Adult Mesenchymal Stem Cells on In Vitro Vascular Formation. *Tiss Eng: Part A* 15(7):1751-1761, 2009.
346. NL Malinin, L Zhang, J Choi, A Ciocea, O Razorenova, YQ Ma, EA Podrez, M Tosi, DP Lennon, AI Caplan, SB Shurin, EF Plow and TV Byzova. A point mutation in kindlin-3 ablates activation of three integrin subfamilies in humans. *Nat Med*, 15, 313-318, 2009.
347. H Park, X. Guo, JS Temenoff, Y Tabata, AI Caplan, FK Kasper, and AG Mikos. Effect of swelling ratio of injectable hydrogel composites on chondrogenic differentiation of encapsulated rabbit marrow mesenchymal stem cells in vitro. *Biomacromolecules*, 10:541-546, 2009.
348. H Park, JS Temenoff, Y Tabata, AI Caplan, RM Raphael, JA Jansen, AG Mikos. Effect of dual growth factor delivery on chondrogenic differentiation of rabbit marrow mesenchymal stem cells encapsulated in injectable hydrogel composites. *J Biomed Matl Res Part A*, 88:889-897, 2009.
349. IH Song, AI Caplan, JE Dennis. Dexamethasone inhibition of confluence-induced apoptosis in human mesenchymal stem cells. *J Orthop Res*, 27:216-221, 2009.
350. L Da Silva Meirelles, TT Sand, RJ Harman, DP Lennon, AI Caplan. MSC frequency correlates with blood vessel density in equine adipose tissue. *Tiss Eng, Part A* 15: 221-229, 2009.
351. JM Sorrell, AI Caplan. Fibroblasts – A diverse population at the center of it all. In *International Review of Cell and Molecular Biology*, Vol. 276, Chapter 4, Pp.159-212, 2009.
352. L Da Silva Meirelles, AM Fontes, DT Covas, AI Caplan. Mechanisms involved in the therapeutic properties of Mesenchymal Stem Cells. *Cytokine Growth Factor Rev*, 20:419-427, 2009.
353. J Wagner, T Kean, R Young, JE Dennis and AI Caplan. Optimizing mesenchymal stem cell-based therapeutics. *Curr Opin Biotechnol*, 20:531-536, 2009.
354. IH Song, AI Caplan, JE Dennis. In vitro dexamethasone pretreatment enhances bone formation of human mesenchymal stem cells in vivo. *J Orthop Res*, 27:916-921, 2009

### 2010

355. LA Solchaga, K Penick, VM Goldberg, AI Caplan and J Welter. Fibroblast growth factor-2 enhances proliferation and delays loss of chondrogenic potential in human adult bone-marrow-derived mesenchymal stem cells. *Tiss Eng Part A*. 1009-1019, 2010.
356. BO Diekman, CR Rowland, DP Lennon, AI Caplan and F Guilak. Chondrogenesis of adult stem cells from adipose tissue and bone marrow: Induction by growth factors and cartilage derived matrix. *Tiss Eng, Part A*, 523-533, 2010.
357. PK Valonen, FT Moutos, A Kusanagi, M Moretti, BO Diekman, JF Welter, AI Caplan, F Guilak, LE Freed. In vitro generation of mechanically functional cartilage grafts based on adult human stem cells and 3D-woven poly ( $\epsilon$ -caprolactone) scaffolds. *Biomaterials*, 31(8):2193-2200, 2010.
358. JM Sorrell, MA Baber and AI Caplan. Influence of adult mesenchymal stem cells on in vitro vascular formation. In: *Advances in Tissue Engineering, Volume 1: Angiogenesis*. Chapter 24, Pp. 241-248, 2010.
359. AI Caplan. Mesenchymal stem cells: The past, the present, the future. *Cartilage* 1(1)6-9, 2010.
360. TL Bonfield, MT Nolan (Koloze), D Lennon, B Zuchowski, SE Yang, AI Caplan. Defining mesenchymal stem cell efficacy in vivo. *J. Inflammation* 7:51 Epub ahead of print, 2010.

## **PUBLICATIONS - Continued**

361. TL Bonfield and AI Caplan. Adult mesenchymal stem cells: An innovative therapeutic for lung diseases. *Discovery Medicine*, 9(47):337-345, 2010.
362. C Abrahamsson, F Yang, H Park, J Brunger, P Valonen R Langer, J Welter, A Caplan, F Guilak, L Freed. Chondrogenesis and mineralization with in vitro culture of human mesenchymal stem cells on 3D-woven scaffolds. *Tiss Eng Part A*. Epub ahead of print doi:10.1089/ten.tea.2010.0190.
363. RH Miller, L Bai, DP Lennon, AI Caplan. The potential of mesenchymal stem cells for neural repair. *Discovery Medicine*, 9(46):236-242, 2010.
364. AI Caplan. What's in a name? *Tiss Eng, Part A*, 16(8):2415-2417, 2010.
365. JM Sorrell and AI Caplan. Topical delivery of mesenchymal stem cells and their function in wounds. *Stem Cell Research & Therapy*, 1:30, 2010.

## **ABSTRACTS**

Over 150 abstracts have been published from 1965 through 1995. The exact number and citations are no longer recorded.

## **PATENTS**

1. Arnold I. Caplan and Glenn T. Syftestad (August 26, 1986). Bone Protein Purification Process. Patent No. 4,608,199.
2. Arnold I. Caplan and Glenn T. Syftestad (November 4, 1986). Process of Adapting Soluble Bone Protein for Use in Stimulating Osteoinduction. Patent No. 4,620,327.
3. Arnold I. Caplan and Stephen E. Haynesworth (March 30, 1993). Method for Enhancing the Implantation and Differentiation of Marrow-Derived Mesenchymal Cells. Patent No. 5,197,985.
4. Arnold I. Caplan and Stephen E. Haynesworth (July 13, 1993). Method for Treating Connective Tissue Disorders. Patent No. 5,226,914.
5. Arnold I. Caplan and Stephen E. Haynesworth (January 23, 1996). Human Mesenchymal Stem Cells. Patent No. 5,486,359.
6. Arnold I. Caplan, Stanton Gerson and Stephen E. Haynesworth (January 7, 1997). Transduced Mesenchymal Stem Cells. Patent No. 5,591,625.
7. Arnold I. Caplan and Stephen E. Haynesworth (July 1, 1997). Monoclonal Antibodies for Human Osteogenic Cell Surface Antigens. Patent No. 5,643,736
8. Arnold I. Caplan, Stanton Gerson and Stephen E. Haynesworth (March 31, 1998). Enhancing Bone Marrow Engraftment Using MSCs. Patent No. 5,733,542.
9. Arnold I. Caplan, Scott P. Bruder and Stephen E. Haynesworth (April 7, 1998). Lineage-Directed Induction of Human Mesenchymal Stem Cell Differentiation. Patent No. 5,736,396.
10. Arnold I. Caplan, David Fink, and Randell Young (January 5, 1999). Biomatrix for Soft Tissue Regeneration. Patent No. 5,855,619.
11. Arnold I. Caplan, Scott P. Bruder and Stephen E. Haynesworth (August 24, 1999). Lineage-Directed Induction of Human Mesenchymal Stem Cell Differentiation. Patent No. 5,942,225.
12. Arnold I. Caplan, Stephen E. Haynesworth, and Stanton L. Gerson. (January 4, 2000). Enhancing Hematopoietic Progenitor Cell Engraftment Using Mesenchymal Stem Cells. Patent No. 6,010,696.
13. Arnold I. Caplan and Stephen E. Haynesworth (July 11, 2000). Monoclonal Antibodies for Human Mesenchymal Stem Cells. Patent No. 6,087,113.
14. Arnold I. Caplan, Scott P. Bruder, James S. Burns, Daniel Markshak. (2000). Bone Regeneration in Osteoporosis Using Human Bone Marrow Mesenchymal Cells. Patent No. EP 1 007 063 A1.
15. Giovanni, A., Callegaro, L., Young, R.G., Murphy, J.M., Fink, D.J, Bruder, S.P., Barry, F.P., Kadiyala, S., Caplan, A.I., Moskowitz, R., Yoo, J.U., and Solchaga, L.S. (November 19, 2002). Biological material for the repair of connective tissue defects comprising mesenchymal stem cells and hyaluronic acid derivative. Patent No. 6,482,231.
16. Arnold I. Caplan and J. Michael Sorrell (December 24, 2002). Multilayer skin or dermal equivalent having a layer containing mesenchymal stem cells. Patent No. 6,497,875.

## **SELECTED ADDRESSES**

17. Arnold I. Caplan and Stephen E. Haynesworth (November 12, 2003). Mesenchymal stem cells and their use. Patent No. EP 1 361 267 A2.
18. VM Goldberg, AI Caplan, FP Barry, DJ Fink, DR Marshak, JS Burns (December 28, 2004). Osteoarthritis cartilage regeneration. Patent No. 6,835,377.
19. D Asselineau and AI Caplan (March 20, 2007). Antibodies specific for papillary fibroblasts as markers for skin quality. Patent No. 7,192,719.
20. AI Caplan, RG Young, JE Dennis (March 9, 2008). Myogenic differentiation of human mesenchymal stem cells. Patent No. EP0852463.

## **SELECTED ADDRESSES (Exclusive of academic seminars)**

### **1968**

Speaker: Gordon Conference on Vitamins and Cofactors; July 1968.

### **1971**

Invited Speaker: Workshop Meeting on "Limb Development," Boulder, Colorado; June 1971. (See Dev. Biol. 27:285-288 (1972) for a summary of this meeting.)

Speaker: Gordon Conference on "Mucopolysaccharides," July 1971.

### **1972**

Invited Speaker: Conference of "Limb Development" sponsored by the International Society of Developmental Biologists, Grenoble, France; August 1972.

### **1974**

Invited Speaker: Second International Santa Catalina Island Colloquium on "Extracellular Matrix Influences on Gene Expression," September 1974.

### **1975**

Invited Participant: Mead-Johnson Symposium on "Clinical and Biological Aspects of Malformations," Vail, Colorado; June 1975.

Speaker: Gordon Conference on "Bones and Teeth," July 1975.

### **1976**

Invited Speaker: Third Symposium of the British Society for Developmental Biology (Cosponsored by The International Society of Developmental Biologists) on "Vertebrate Limb and Somite Development," Glasgow, United Kingdom; September 1976.

### **1977**

Symposium Lecturer: Fifth International Conference on "Birth Defects," Montreal, Canada; August 1977.

### **1978**

Invited Participant: Dahlem Konference on "Fetal Growth," Berlin, Germany; February 1978.

Invited Participant: W. Alton Jones Cell Science Center, "Structure and Metabolism of Proteoglycans in Cultured Cells"; February 1978.

Invited Lecturer: Conference on the "Biology of Cervical Dilatation"; August 1978.

### **1979**

Invited Lecturer and Rapporteur: Fogarty International Conference on "Novel ADP-Ribosylations of Regulatory Enzymes and Proteins," Washington, D.C.; October 1979.

### **1980**

Symposium Lecturer: AAAS Annual Meeting, San Francisco, California; January 1980.

Symposium Lecturer: Annual Meeting of the National Science Teachers Association, Anaheim, California; March 1980.

Invited Participant: EMBO Workshop on "Muscle Cell Culture in the Study of Gene Expression During Differentiation," Shoshon, Israel; March 1980.

Symposium Lecturer: Midwest Connective Tissue Workshop, Cleveland, Ohio; May 1980.

Symposium Lecturer: 39th Symposium of the Society for Developmental Biology, Storrs, Connecticut; June 1980.

### **1981**

Invited Participant: VI<sup>th</sup> International Symposium on Glycoconjugates, Tokyo, Japan; September 1981. Satellite meeting on "Proteoglycans," Hakone, Japan.

### **1982**

Invited Participant: XV<sup>th</sup> EMBO International Embryology Conference, Strasbourg, France; June 1982.

Organizer and Participant: "Third International Conference on Limb Development and Regeneration," Storrs, Connecticut; June 1982.

## **SELECTED ADDRESSES**

Workshop on Limb Development organized by NIHCD, Washington, D.C.; September 1982.

### **1983**

Invited Lecturer: 3rd EMBO Workshop on "Molecular and Cellular Aspects of Myogenesis and Myofibrillogenesis in Cell Cultures of Normal and Diseased Muscle," Boldern, Switzerland; March 1983.

Invited Lecturer: "Workshop on Local Mechanisms Regulating Bone Formation," NIDR/NIH, Bethesda, Maryland; May 1983.

Invited Lecturer: Gordon Research Conference, "The Biochemistry and Physiology of Bones and Teeth"; July 1983.

Invited Lecturer: Midwest Connective Tissue Workshop, Northwestern University, Chicago, Illinois; October 1983.

Distinguished Lecturer Series: University of Texas Health Science Center, Dallas, Texas; November 1983.

Mini Symposium Lecturer: 23rd Annual Meeting, The American Society for Cell Biology, San Antonio, Texas; November/December 1983.

### **1984**

Invited Lecturer: Third Annual Mid-Atlantic States Regional Meeting of the Society for Developmental Biology, Millersville University, Millersville, Pennsylvania; April 1984.

Invited Participant and Session Chairman: Gordon Conference on Proteoglycans, Plymouth State College, New Hampshire; June 1984. Invited Participant: "The Second International Conference on the Chemistry and Biology of Mineralized Tissues," Gulf Shores, Alabama; September 1984.

Invited Lecturer: Seventh International Symposium on ADP-Ribosylation Reactions, Vitznau, Switzerland; September 1984.

Invited Lecturer: 1984 Annual Meeting of the Society of Complex Carbohydrates," Chicago, Illinois; October 1984.

### **1985**

Plenary Lecturer: UCLA Meetings on "Molecular Biology of Muscle Development," Park City, Utah; March 1985.

Session Chairman: 25th Annual Midwest Regional Developmental Biology Meetings, Cleveland, Ohio; May 1985.

Workshop on Arthritis organized by NIH, Warrenton, Virginia; July 1985.

Plenary Lecturer: Tenth International Congress of the International Society of Developmental Biologists, Los Angeles, California; August 1985.

Mini Symposium Lecturer: 25th Annual Meeting, The American Society for Cell Biology, Atlanta, Georgia; November 1985.

### **1986**

Invited Participant: CIBA Foundation Symposium on "Functions of the Proteoglycans," London, England; January 1986.

Invited Participant: 7th International Workshop on Calcified Tissues, Ein Gedi, Israel; March 1986. Symposium Lecturer: 1986 American Association for Dental Research, Washington, D.C.; March 1986.

Platform Lecturer: UCLA Meeting on "Development and Diseases of Cartilage and Bone Matrix," Lake Tahoe, California; March 1986.

Symposium Lecturer: Annual Teratology Society Meeting, Boston, Massachusetts; July 1986.

Invited Participant and Lecturer: Gordon Research Conference on "Bioengineering and Orthopedic Sciences," Proctor Academy, Andover, New Hampshire; August 1986.

Invited Participant and Lecturer: EMBO Meeting on "Molecular Biology of Muscle Development," Bendor, France; August/September 1986.

Symposium Lecturer: "The Biology of Tooth Movement," University of Connecticut, Farmington, Connecticut; November 1986.

Distinguished Lecturer: Columbia University, College of Physicians and Surgeons, Department of Orthopaedics, New York, New York; December 1986.

### **1987**

Organized and conducted: "Workshop on Hard Tissue and Ceramics," Santa Barbara, California; January 1987.

Invited Participant: "8th International Symposium on ADP-Ribosylation," Fort Worth, Texas; May/June 1987.

Invited Participant and Group Leader: "NIH/AAOS Workshop on Injury and Repair of the Musculoskeletal Soft Tissues," Savannah, Georgia; June 1987.

Invited Participant: MDA "Colloquium on Growth Regulation in Normal and Dystrophic Muscle," MIT Endicott House, Dedham, Massachusetts; July/August 1987.

Symposium Lecturer at the Annual Meeting of the Chilean Society of Biology (Cell Biology Section), Santiago, Chile; September 1987.

## SELECTED ADDRESSES

Invited Participant: Battelle Pacific Northwest Laboratories/U.S. Department of Energy workshop on "Chemistry at Interfaces," Richland, Washington; October 1987.

Invited Lecturer and Proposer: CIBA Foundation Symposium No. 137, "Cell and Molecular Biology of Hard Tissue," London, England; October 1987.

Invited Lecturer, "Midwest Connective Tissue Workshop," Chicago, Illinois; November 1987. Keynote Speaker: "Conference on Mineralized Tissues and Biomaterials," Bordeaux, France; December 1987.

### 1988

Invited Discussant: "Second International Workshop on Cells and Cytokines in Bone and Cartilage," Davos, Switzerland; April 1988.

Organizer and Participant: "Bioactive Factors from Bone: A Celebration for Marshall Urist," San Antonio, Texas; May 1988.

Invited Participant: Third Annual Bone Workshop, "The Role of Growth Factors in Bone Formation," sponsored by Merck Sharp & Dohme Research Laboratories, Branchburg Farms, New Jersey; July 1988.

Invited Participant: "Workshop on Myocardial Regeneration," Rockefeller University, New York, New York; June 1988. Invited Participant: "Workshop on Bone Healing," Genentech, Inc., San Francisco, California; August 1988.

Invited Speaker: "Third Annual Meeting of the Orthopaedic Research Society of Japan," Tokyo, Japan; September 1988.

Invited Lecturer and Chairperson: "The Third International Conference on the Chemistry and Biology of Mineralized Tissues," Chatham, Massachusetts; October 1988.

Invited Lecturer: "Midwest Connective Tissue Workshop," Chicago, Illinois; November 1988.

### 1989

Invited Lecturer: "International Symposium on Recent Advances in Drug Delivery Systems," Salt Lake City, Utah; February 1989.

Invited Lecturer: "The XXI European Symposium on Calcified Tissues," Jerusalem, Israel; March 1989.

Organizer and Symposium Lecturer: "Cellular and Molecular Biology of Skeletal Repair," Cleveland, Ohio; April 1989.

Invited Participant: "Bone Biology Workshop," organized by Merck Sharp & Dohme Research Laboratories, Branchburg Farms, New Jersey; June 1989.

Invited Lecturer: Gordon Research Conference, "Biology of Aging," Plymouth, New Hampshire; July 1989.

Invited Lecturer: "National Conference on Biotechnology Ventures," Redwood Shores, California; November 1989.

Invited Lecturer: "Controversies of Total Knee Arthroplasty: Issues for the Nineties," sponsored by The Knee Society, Phoenix, Arizona; November 1989.

Invited Lecturer: "Materials Research Society, Fall Meeting," Boston, Massachusetts; November/December 1989.

Invited Lecturer: "Conference on Mineralized Tissue and Biomaterials," Bordeaux, France; December 1989.

### 1990

Distinguished Professor Lecture: Hospital for Special Surgery, Cornell Medical School, New York, New York; February 1990.

Kappa Delta Award Lecture at the Annual Meeting of the American Academy of Orthopaedic Surgeons, New Orleans, Louisiana; February 1990.

Invited Lecturer: UCLA Symposium on "Tissue Engineering," Keystone, Colorado; April 1990.

Invited Lecturer: NATO Advanced Research Workshop, "Developmental Patterning of The Vertebrate Limb," Santander, Spain; September 1990.

Invited Lecturer: Ohio Symposium on "Advances in Biomaterials Science and Engineering," Cleveland, Ohio; October 1990.

Invited Lecturer: Midwest Connective Tissue Workshop, Chicago, Illinois; November 1990.

Invited Participant: Workshop on "The Bone Biomaterials Interface," Toronto, Canada; December 1990.

### 1991

Organizer/Participant: Workshop on "Materials Processing Strategies for Producing Useful Ceramic Materials Biomimetically," San Diego, California; January 1991.

Invited Lecturer: "International Update on Bone Allografts Symposium," Washington, D.C.; April 1991.

Organizer/Participant: Workshop on "Orthopaedic Applications of Growth Factors," Indianapolis, Indiana; April 1991.

Invited Lecturer: "Annual Meeting of the Scanning Microscopy Society," Bethesda, Maryland; May 1991.

Invited Lecturer: "International Conference on the Biological Mechanisms of Tooth Movement and Craniofacial Adaptation," Columbus, Ohio; May 1991.

## SELECTED ADDRESSES

Invited Lecturer: "European Developmental Biology Congress," Jerusalem, Israel; August 1991.

Invited Lecturer: Midwest Connective Tissue Workshop, Chicago, Illinois; November 1991.

Invited Lecturer: Workshop on "Biology of Biomechanics of Synovium: The Knee as a Model," Scottsdale, Arizona; November 1991.

### 1992

Invited Lecturer: Controlled Release Society Workshop: "Biomaterials, Fundamentals, Applications and Recent Developments," Jupiter Beach, Florida; January 1992.

Invited Lecturer: "4th International Conference on Calcified Tissues," Del Coronado (San Diego), California; February 1992.

Invited Lecturer: Keystone Symposia on Molecular and Cellular Biology: "Tissue Engineering," Keystone, Colorado; April 1992.

Invited Lecturer: "Biotech Ohio," Columbus, Ohio; May 1992.

Invited Participant: "4th International Conference on Limb Development and Regeneration," Asilomar (Pacific Grove), California; June 1992. Invited Participant: "Frontiers in Rehabilitation Medicine: Osteogenesis Imperfecta," NIH, Bethesda, Maryland; September 1992.

Invited Participant: Midwest Connective Tissue Workshop, Chicago, Illinois; October 1992.

Invited Lecturer: European Research Conference, "Biology of Cartilage and Bone: Molecular and Cellular Aspects," sponsored by European Science Foundation, Obernai, France; November 1992.

### 1993

Invited Lecturer: "The Biological Approach to Hard and Soft Tissue Reconstruction and Repair Processes" Centennial Celebration, Dental School/Northwestern University, Chicago, Illinois; January 1993.

Invited Lecturer: Ralph V. McKinney, Jr. Memorial Symposium, "Experimental Evaluations of the Bone-Dental Interface," IADR/AADR Annual Meeting, Chicago, Illinois; March 1993.

Invited Lecturer: "Bone Repair and Osteoporosis", IBC Conference, San Francisco, CA; June 1993.

Invited Lecturer: "Portland Bone Symposium," Portland, Oregon; July 1993.

Invited Lecturer: "Frontiers of Implant Science" Symposium, American Academy of Implant Dentistry Regional Foundation Annual Meeting, Dallas Texas; October 1993.

Invited Lecturer: "International Conference on the Biological Mechanisms of Tooth Eruption, Resorption and Replacement by Implants," Danvers, Massachusetts; October 1993.

Invited Participant: "Bone Repair" Symposium, National Institutes of Health/American Academy of Orthopaedic Surgeons Conference, Tampa, Florida; November 1993.

### 1994

Invited Lecturer: "Symposium on BMP and Bone Repair," Johns Hopkins University, Baltimore, Maryland; June 1994.

Invited Lecturer: "FASEB Summer Research Conference on Repair and Regeneration: At the Interface," Saxtons River, Vermont; July 1994.

Invited Lecturer: "Gordon Research Conf on Bioengineering and Orthopaedics Sciences,"; August 1994.

Invited Lecturer: "European Tissue Culture Soc Symp on Applied Cell Culture," Verona, Italy; Oct 1994.

Invited Lecturer: "Annual Meeting of the National Capital Area Tissue Culture Society," College Park, Maryland; October 1994.

### 1995

Invited Lecturer: "Developmental Biology" Graduate Course, University of Puerto Rico, San Juan, Puerto Rico; February 1995.

Invited Lecturer: "International Symposium on Bone and Soft Tissue Allografts," Musculoskeletal Transplantation Foundation, Washington, D.C.; April 1995.

Invited Lecturer: "Portland Bone Meeting," Portland, Oregon; August 1995.

Invited Lecturer: "Tissue Engineering and Bone/Cartilagel Stimulation," IBC Conference, Washington, D.C.; August 1995.

Session Chair and Presenter: "5th International Conference on the Chemistry and Biology of Mineralized Tissue," Kohler, Wisconsin; October 1995.

Invited Lecturer: "Second International Symposium on Fibrodysplasia Ossificans Progressiva," Philadelphia, Pennsylvania; October 1995.

Invited Lecturer: "Second Combined Meeting of the USA, Japanese, Canadian and European Orthopaedic Research Societies," Del Coronado, California; November 1995.

### 1996

Invited Lecturer: "Tissue Engineering/Wound Repair," Keystone Symposia on Molecular and Cellular Biology, Taos, New Mexico; January 1996.

Invited Lecturer: "Stem Cells," Branbury Conference, Cold Spring Harbor, NY; February 1996

## SELECTED ADDRESSES

- Invited Lecturer: "Fifth Internl Workshop on Calcified Tissues," Jerusalem, Israel; March 1996.  
Invited Lecturer: National Disease Research Interchange. "Frontiers in Human Tissue Research". Philadelphia, PA; April 1996.  
Invited Lecturer: "Scientific Frontiers in Clinical Density," NIH, Bethesda, Maryland; June 1996.  
Invited Lecturer: "6th International Conference on the Molecular Biology and Pathology of Matrix," Philadelphia, Pennsylvania; June 1996.  
Invited Lecture: Washington, DC section of AADR, Dental & Medical Materials Group of N.I.S.T., NIH, Bethesda, MD, June, 1996  
Symposium Lecture: "The Intl Cong on Human Cell and Cell Culture", Tokyo, Japan, August, 1996.  
Invited Plenary Lecture: "Third International Congress of the Cell Transplant Society," Miami Beach, Florida, September 1996.

### 1997

- Invited Lecture: Keystone Symposia on Molecular and Cellular Biology, "Biology of Sarcomas II: Molecular, Pathologic, and Oncologic Aspects of Mesenchymal Growth and Differentiation," Copper Mountain, Colorado. February 1997.  
Invited Lecture: Gordon Conf on "Wound Repair". Colby-Sawyer College, New Hampshire. June, 1997.  
Invited Lecture: Workshop on "Osteobiology", Salsomaggiore, Italy. June, 1997.  
Invited Lecture: "International Symposium on Gene Therapy for Single Gene Disorders," Helsinki, Finland, June, 1997.  
Invited Lecture: Fifth Annual Course on "Advances in Tissue Engineering" Rice University, Houston, Texas, August, 1997.  
Invited Lecture: 7th Ann. Mtg. of the "European Tissue Repair Society", Cologne, Germany, August, 1997.  
Invited Lecture and Session Chair: IBC Conference on "Skin Substitutes", Boston, MA, September, 1997.  
Invited Lecture: European Tissue Culture Society Annual Meeting. Mainz, Germany. October, 1997.  
Invited Lecture/Participant: Workshop on "Fracture Repair Agumentation" Organized by the Association of Bone and Joint Surgeons and the Intl Society for Fracture Repair. Tampa, Florida, October, 1997.

### 1998

- Invited Lecture: Harvard University "Biology, Biochemistry and Physiology of the Skeletal Systems of Vertebrate," Boston, MA, February, 1998.  
Invited Lecture: Tissue Engineering Course: Food and Drug Administration, Rockville, MD, March,  
Invited Lecture: 1998 MSGSA Symposium the University of Calgary, Alberta, Canada, April, 1998.  
Invited Lecture: The Cleveland Clinic Foundation, Division of Rheumatology and Immunologic Diseases, Cleveland, Ohio, May, 1998.  
Invited Lecture: The 50<sup>th</sup> Anniversary of the Dental School Research Symposium. University of Alabama, Birmingham, Alabama, May, 1998.  
Invited Lecture: Tissue Engineering Course, Rice University, Houston, Texas, August, 1998.  
Plenary Lecture: "North Sea Biomaterials Conference" and "The 14<sup>th</sup> European Society for Biomaterials Conference." The Hague, The Netherlands, September, 1998.  
Invited Lecture: Annual Meeting of the Biomedical Engineering Society, Cleveland, Ohio, October, 1998.  
Organizer and Lecturer: Orthopaedic Tissue Engineering Workshop, Tampa, Florida, November, 1998.  
Plenary Lecture: "Second Tissue Engineering Society Meeting" Orlando, Florida, December, 1998.  
Invited lecture: "2<sup>nd</sup> SIS Symposium," Orlando, Florida, December, 1998.

### 1999

- Invited Lecture: IBC 2<sup>nd</sup> Annual Conference on "Orthopaedic Biomaterials," Cambridge, MA, March,.  
Presidential Guest Lecture: 72<sup>nd</sup> Annual Mtg of the Japanese Orthop. Assn, Yokohama, Japan, April, 1999.  
Invited Lecture and Session Chair: Workshop on "Cartilage Repair," Lake Tahoe, California, June, 1999.  
Invited Participant: New Frontiers in Medical Science "Redefining Hyaluronan," Padua, Italy, June, 1999.  
Symposium Lecture: The 5th Annual Orthop. Symposium, School of Medicine, Stony Brook, NY, June, 1999.  
Session Chair: "Portland Bone Symposium," Portland, Oregon, August, 1999.  
Invited Lecture: "Advances in Tissue Engineering," Rice University, August, 1999.  
Symposium Lecture: "4<sup>th</sup> Intl. Symposium of Tissue Eng. for Therapeutic Use." Kyoto, Japan, September, 1999.  
Symposium Lecture: 14<sup>th</sup> Annual Orthopaedic Research Meeting, Nara, Japan, October, 1999.  
Symposium Lecture: Fondation Rene Touraine Pour La Recherche Dermatologie, "Extracellular Matrix." Paris, France, October, 1999.  
Participant/Group Leader: Technology Forum Workshop: NIH/FDA, Bethesda, MD, November, 1999.  
Invited Lecture: ABJS Workshop "Orthopaedics and Gene Therapy" Tampa, FL, November, 1999.  
Invited Participant: Bone Engineering International Workshop, Institute for Biomaterials and Biomedical Engineering, University of Toronto, November, 1999.

## SELECTED ADDRESSES

### 2000

- Invited Lecture: Tissue Engineering Symposium, Pittsburg, PA, April, 2000.  
Invited Lecture: Cartilage Repair Society Annual Meeting, Tossburg, Sweden, April, 2000.  
Invited Lecture: NYAS "Tissue Repair and Remodeling in Arthritis," New York City, NY, May, 2000.  
Invited Lecture: Symposium on "Stem Cells in the Embryo and in the Adult Prospects for Therapy." Collège de France, Paris, May, 2000.  
Invited Lecture: Gordon Research Conference, "Signal Transduction by Engineered Extracellular Matrices," June, 2000.  
Invited Lecture: "HA 2000" Conference, Wales, Great Britain, September, 2000.  
Invited Lecture: "Functional Tissue Engineering Workshop" Sponsored by the U.S. Nat'l Committee on Biomechanics, Tampa, FL, September, 2000.  
Invited Lecture: ABJS "Articular Cartilage Repair 2000" Tampa, FL, November, 2000.  
Invited Lecture/Organizer: L'Oreal Symposium on "The Science and Technology of Skin" Lyon, France, October, 2000.  
Invited Lecture: Italian Orthopaedics Society Annual Meeting. Torino, Italy, October, 2000.  
Invited Lecture: Annual ASTM Meeting. "Cell-Based Therapies," Orlando, FL, November, 2000.  
Invited Lecture and Teaching Seminar: "The Art of Tissue Engineering 2000" Utrecht, The Netherlands, November 2000.  
Invited Lecture: Engineering Orthopaedics, University of Michigan, Ann Arbor, MI, December 2000.

### 2001

- Invited Lecture: Annual Research Meeting of Otolaryngology Society. "Tissue Engineering Symposium" St. Petersburg, FL, February 2001.  
Organizer/Lecture: Workshop on "STEM CELLS" at the Annual Meeting of the Orthopaedic Research Society, Dallas, Texas, February 2002.  
Invited Lecture: Ernst Klenk Symposium. "Stem Cells" Cologne, Germany, February, 2001.  
Invited Lecture: Arthritis Foundation Research Conference. San Diego, CA, March 2001.  
Invited Lecture/Organizer: Engineering Tissue Growth, International Conference, Pittsburgh, PA, March.  
Invited Lecture: Experimental Biology/Am. Soc. Of Investigative Pathology, Orlando, FL, April 2001.  
Organizer: Midwest Tissue Engineering Consortium Annual Meeting, Cleveland, Ohio, April 2001.  
Invited Lecture: European Congress of Rheumatology. Symposium on Stem Cells, Prague, Czech Republic, June 2001.  
Invited Lecture: World Congress of Biomedical Engineering. "Tissue Engineering Symposium" and "Toxicology of Skin Symposium." St. Louis, MO., June 2001.  
Invited Participant: BECON 2001. "Reparative Medicine: Growing Tissues and Organs" NIH, Bethesda, MD, June 2001.  
Invited Participant: Stem Cell Workshop, NIH, Bethesda, MD, August 2001.  
Invited Lecturer: Annual Midwest Seminars of Dental Medicine, Green Bay, WI, September, 2001.  
Invited Lecturer: Topics in Geriatric Medicine. Veterans Administration Hospital, Cleveland, OH, September, 2001.  
Invited Participant: Osteogenesis Imperfecta. NIH Workshop, Chicago, IL, December, 2001.  
Invited Lecturer: Symposium on Stem Cells, Eli Lilly Corporation, Indianapolis, IN, October, 2001.  
Invited Lecture: World Congress of the OsteoArthritis Research Society International. Washington, DC, October 2001.  
Invited Lecturer: "Tecvest 2001" New York, NY, October 2001.  
Invited Keynote Lecturer: Binnial Meeting of the European Tissue Engineering Society, Freiburg, Germany, November, 2001.

### 2002

- Invited Lecture: New Frontiers in Science and Technology Lecture Series. University of Buffalo Medical School, Buffalo, NY, January 2002.  
Invited Lecture: "AO Conference on Cell Therapies in Orthopaedics", Zurich, Switzerland. March, 2002.  
Invited Lecture: "MSCs and their use in Skeletal Tissue Regeneration", London, Ont. Canada, March, 2002.  
Invited Lecture: Engineering Tissue Growth, Pittsburgh, PA, March 2002.  
Invited Lecture: North American Vascular Biology Organization, Workshop on Tissue Engineering, Salt Lake City, Utah. April, 2002.  
Invited Lecture and Meeting Moderator: Novartis Foundation Symposium #249 on Tissue Engineering, London, England, April, 2002.  
Organizer/Founder: Midwest Tissue Engineering Consortium, 2<sup>nd</sup> Meeting, Ann Arbor, MI. April, 2002  
Invited Lecture: McGowan Institute Distinguished Lecture Series, Pittsburgh, PA. April, 2002.

## SELECTED ADDRESSES

- Invited Lecture: Society for Biomaterials Annual Meeting, Tampa, FL. April, 2002.  
Invited Lecture: Senior Day Symposium, Park Synagogue, Cleveland Heights, OH. May 2002.  
Invited Lecture: Symposium on TMJ, NIH, Bethesda, MD 2002.  
Invited Lecture/Session Chair: Aegean Conference on Tissue Engineering, Myconos, Greece. May, 2002.  
Organizer/Lecture: Short Course on "Cell-Based Therapies and Tissue Engineering", Case Western Reserve University, Cleveland, OH. May, 2002.  
Invited Lecture: Cartilage Repair Society Annual Meeting. Toronto, Canada, June, 2002.  
Invited Lecture: Gordon Res. Conferences on Signal Transduction and Tissue Engineering. June, 2002.  
Invited Lecture: Baltic Stem Cell Conference, University of Rostock, Rostock, Germany. June, 2002.  
Invited Lecture: 10<sup>th</sup> Annual Tissue Engineering Course, Rice University, Houston, TX. August, 2002.  
Organizer/Lecture: International Symposium on Aging of Skin. Cleveland, OH, September, 2002.  
Invited Lecture/Course Director: Annual Meeting of the Society for Otolaryngology, San Diego, CA. September, 2002.  
Invited Lecture: Italian Orthopaedic Society, Bologna, Italy. October, 2002.  
Invited Lecture: ICCG and JSGST Symposium. Kyoto, Japan, October, 2002.  
Invited Lecture: Cold Spring Harbor Laboratory Meeting on Stem Cells, Long Island, NY. Nov., 2002.  
Invited Lecture: 1<sup>st</sup> Intl. Mtg. of the Stem Cell Network. North Rhine Westphalia, Düsseldorf Germany, November 2002.  
Invited Lecture: University of Texas, San Antonio. Distinguished Professor Lecture. December, 2002.
- 2003**
- Invited Chair/Participant: AAOS Workshop, "Tissue Engineering in Musculoskeletal Clinical Practice" Santa Fe, NM. January, 2003.  
Invited Lecturer: 2003 Alpha Group Educational Workshop. Antigua. February, 2003.  
Invited Lecturer/Organizer: 3<sup>rd</sup> Engineering Tissue Growth Intl. Conf. and Exposition. Pitts., PA, March 2003.  
Invited Lecturer: 29<sup>th</sup> Mtg. of the Society for Biomaterials. Reno, NV, April 2003.  
Invited Lecturer: Keystone Conference "Stem Cells", Steamboat Springs, CO, April 2003.  
Invited Lecturer: Research Frontiers Symposium. University of Alabama, Birmingham, AL, April 2003.  
Organizer: Midwest Tissue Engineering Meeting. Cincinnati, OH, April 2003.  
Invited Lecturer: Gerontology Inst. Workshop on Stem Cells. Univ. of Michigan, Ann Arbor, MI, May 2003.  
Organizer: 2<sup>nd</sup> Annual Cell-Based Therapies and Tissue Engineering Short course (CTTE-2003), Case Western Reserve University, Cleveland, May 2003.  
Webcast: Invited by Tissue Engineering Society, June 2003.  
Invited Lecturer: 2<sup>nd</sup> Mtg. of the Institute of Arthritis and Pain. Vienna, July 2003  
Invited Lecturer: Alegen Healthcare Institute, Omaha, NB, August 2003.  
Invited Lecturer: Distinguished Scientist Lecture Series "Health Sciences and Engineering" Dept. of Biomedical Engineering, University of Michigan, Ann Arbor, MI, October 2003.  
Invited Lecturer: Workshop on Osteogenesis Imperfecta, New York, NY, October 2003.  
Invited Lecturer: Glaxo/Smith/Kline Stem Cell Symposium, Philadelphia, PA, October 2003.  
Invited Lecturer: Workshop on Osteoarthritis (ABJS). Tampa, FL, November 2003.  
Invited Lecturer: International Biomaterials Conference, Japan, December 2003.
- 2004**
- Invited Lecturer: The Bone Summit (International Meeting), Cleveland, OH, May 2004.  
Invited Lecturer: International Cartilage Repair Society, Ghent, Belgium, May 2004.  
Organizer: 3<sup>rd</sup> Annual Cell-Based Therapies and Tissue Engineering Short course (CTTE-2004), Case Western Reserve University, Cleveland, May 2004.  
Invited Lecturer: Distinguished Scientist Lecture Series, Mayorca, Spain, June 2004.  
Invited Lecturer: Tissue Engineering Symposium LEMI, Bordeaux, France, June 2004.  
Instructor: Medical Uses of Hyaluronan, Sanofi Course, New York, NY, June 2004.  
Invited Lecturer: Tissue Engineering Course, Rice University, Houston, TX, August 2004.  
Invited Lecturer: BioCity Symposium on Regenerative Medicine, Turku, Finland, August 2004.  
Invited Lecturer: NCI: CTER Symposium Sacroma and MSCs, Washington, DC, September 2004.  
Invited Lecturer: Musculoskeletal Ventures Symposium, Memphis, TN, October 2004.  
Invited Lecturer: BioCity Symposium on Stem Cells, Stuttgart, Germany, November 2004.
- 2005**
- Invited Lecturer: MSCs and Tissue Engineering and New Insights into Aging, Departments of Cell Biology and Pathology, UCSF, San Francisco, CA, January 2005.  
Invited Lecturer: Regenerate 2005, Hilton Head SC, March 2005.

## RESEARCH SUPPORT

Invited Lecturer: Knowles Lecture, Arthritis Foundation, San Francisco, CA, April 2005.  
Invited Lecturer: The Cartilage Summit, Cleveland OH, May 2005.  
Invited Lecturer: Tissue Engineering Symposium, Warsaw, Poland, May 2005.  
Invited Lecturer: 2<sup>nd</sup> International Conference on Tissue Engineering, Crete, Greece, May 2005.  
Organizer: 4<sup>th</sup> Annual Cell-Based Therapies and Tissue Engineering Short course (CTTE-2005), Case Western Reserve University, Cleveland, May 2005.  
Invited Lecturer: IX International Conference on Osteogenesis Imperfecta, Annapolis, MD, June 2005.  
Distinguished Lecturer: Division of Orthopaedics, University of California at Sacramento, CA, June 2005.  
Invited Lecturer: Tissue Engineering Course, Rice University, Houston, TX, August 2005.  
Invited Lecturer: LOEX Symposium 2005, Sainte Foy, Quebec Canada, September 2005.  
Invited Lecturer: Current Progress in Tissue Engineering and Regenerative Medicine, Harvard University Review Course, Boston, MA, September 2005.  
Invited Advisor/Participant: Annual Australian Stem Cell Centre International Scientific Advisory Board Meeting, Melbourne, Australia, November 2005.  
Invited Lecturer: Regenerative Medicine Institute, National Centre for Biomedical Engineering and Science, National University of Ireland, Galway Ireland, October 2005.  
Invited Lecturer: The 13<sup>th</sup> Annual Congress of the European Society of Gene Therapy, Prague, Czechoslovakia, October 2005.

## 2006

Invited Participant: American Orthopaedic Society for Sports Medicine, La Jolla, CA, January 2006.  
Invited Keynote Speaker: International Cartilage Repair Society Meeting, San Diego, CA, January 2006.  
Invited Keynote Speaker: 24<sup>th</sup> Scientific Conference Society Physical Regulation in Biology and Medicine, Cancun, Mexico, January 2006.  
Invited Lecturer: Buck Institute and CHORI (Oakland), San Francisco, CA, January 2006.  
Invited Participant: Workshop on Pain and Osteoarthritis, Phoenix, AZ, January 2006.  
Keynote Speaker: Adult Stem Cell Summit, Chicago, IL, March 2006.  
Organizer/Participant: InterWest Workshop on Cell-Based Therapy, Napa Valley, CA, April 2006.  
Invited Lecturer: 6<sup>th</sup> Regenerate International Conference and Exposition, Pittsburgh, PA, April 2006.  
Organizer: 5<sup>th</sup> Annual Cell-Based Therapies and Tissue Engineering Short course (CTTE-2006), Case Western Reserve University, Cleveland, May 2006.  
Invited Speaker: BioMed 2006, Jerusalem, Israel, June 2006.  
Invited Seminar: Cell Biology Department, Tel Aviv University, Israel, June 2006.  
Invited Speaker: AO Trustees Meeting (Stem Cells). Berne, Switzerland, June 2006.  
Invited Participant: ISSCR Meeting, Toronto, Canada, July 2006.  
Invited Speaker: CHI CELLutions Summit, Boston, MA, August 2006.  
Invited Speaker: 14<sup>th</sup> Annual Tissue Engineering Course, Rice University, Houston, TX, August 2006.  
Invited Lecturer: International Meeting "Embryonic and Somatic Stem Cells-Regenerative Systems for Cell and Tissue Repair", Dresden, Germany, September 2006.  
Organizer: After Meeting Think Tank Shoulder Society, Chicago, IL, September, 2006.  
Invited Speaker: AAOS Development in Orthopaedics. Toronto, Canada, October, 2006.  
Invited Speaker: Marshall S. Levy, MD, Memorial Lecture, Pittsburgh, PA, November, 2006.

## 2007

Invited Lecturer: Center for Cranial Facial Biology, USC, Los Angeles, CA, January 2007.  
Organizer/Lecturer: NSF/NIH Workshop on Tissue Engineering, Regenerative Medicine and Stem Cells, Arlington, VA, February 2007.  
Invited Lecturer: Stem Cell Summit, San Diego, CA, February 2007.  
Invited Lecturer: Genzyme Corporation, Boston, MA, February 2007.  
Invited Lecturer: Grand Rounds, Department of Rheumatology, UH, CWRU, March 2007.  
Invited Lecturer: Annual Meeting Veterinary Orthopaedic Surgeons, Sun Valley, ID, March 2007.  
Invited Lecturer: Graduate Student Research Day, University of Toledo, Toledo, OH, March 2007.  
Invited Lecturer: Keystone Conference "Development and Tissue Engineering", Snowbird, UT, April 2007.  
Invited Lecturer: International Workshop on Hyaluronan, Charleston, SC, April 2007.  
Invited Lecturer: Workshop on Functional Tissue Engineering, Hilton Head, SC, April 2007.  
Invited Lecturer: Melvin Glimcher Symposium, Harvard University, Boston, MA, May 2007.  
Invited Lecturer: Regenerative Medicine Conference, University of Toronto, Toronto, Canada, June 2007.  
Invited Lecturer/Session Chair: TERMIS North America, Toronto, Canada, June 2007.  
Invited Lecturer: 15<sup>th</sup> Annual Tissue Engineering Course, Rice University, Houston, TX, August 2007.  
Invited Lecturer: Internal Symposium on Regenerative Medicine, Mulhouse, France, September 2007.

## RESEARCH SUPPORT

Invited Lecturer: International Cartilage Repair Society, Warsaw, Poland, September 2007.

Invited Lecturer: Department of Cell and Molecular Biology Seminar and also the Graduate Stem Cell Course, University of North Carolina at Chapel Hill, October 2007.

Invited Lecturer: Department of Experimental Medicine and Pathology, Medical School, Università La Sapienza, Rome, Italy, November 2007.

Invited Lecturer: Italian Society of Orthopaedics and Trauma Annual Meeting, Bologna, Italy, November 2007.

Invited Lecturer: Harvard Stem Cell Institute, Boston, MA, November 2007

Invited Lecturer: The McKnight Brain Institute's Program in Stem Cell and Regenerative Medicine. Amelia Island, FL, December 2007.

### 2008

Invited Lecturer: Department of Cell Biology and Anatomy Seminar Program, Medical University of South Carolina; Charleston, SC, January 2008.

Invited Lecturer: The Stem Cell Summit; New York, NY, February, 2008.

Invited Lecturer: International Chinese Hard Tissue Society Symposium; San Francisco, CA, March 2008.

Invited Lecturer: ORS/AAOS, Combined Symposium; San Francisco, CA, March 2008.

Invited Lecturer: Biomedical Engineering Department; Distinguished Lecturer, Johns Hopkins University, Baltimore, MD, April 2008.

Keynote Speaker: Midwest Tissue Engineering Consortium, Cincinnati, OH, April, 2008.

Invited Lecturer: Academy of Medical Sciences, Moscow, Russia, April 2008.

Invited Lecture: Moscow Orthopaedic Institute, Moscow, Russia, April 2008.

Invited Lecturer: The Cartilage Summit, Cleveland Clinic Foundation; Cleveland, OH, May 2008.

Invited Lecturer: Distinguished Professor Lecture, Hospital for Special Surgery, New York, NY, May 2008.

Invited Member: Biomaterials National Program: Meeting of International Scientific Advisory Panel, Utrecht, The Netherlands, June, 2008.

Invited Lecturer: Stem Cell Symposium, Catholic University, Seoul, S. Korea, June, 2008.

Invited Lecturer: Department of Medical Biology. Daegu University, Daegu, S. Korea, June, 2008.

Invited Lecturer: Cell Signaling and Regenerative Medicine, Gordon Research Conference, Lewiston, Maine, July, 2008.

Organization and Lectured: Second Annual Executive Education Course in "Regenerative Medicine and Entrepreneurism", Cleveland, OH, July 2008.

Organizer and Lecturer: MSC 2008, Regenerative Medicine & Adult Stem Cell Therapy International Meeting, Cleveland, Ohio, August, 2008.

Invited Lecturer: 15<sup>th</sup> Annual Tissue Engineering Course, Rice University, Houston, TX, August, 2008.

Invited Lecturer: Science of Autism Meeting, Thoughtful House, Austin, TX, September, 2008.

Invited Lecturer: Department of Biology, Graduate Department Seminar Series, Cleveland State University, Cleveland, Ohio, October, 2008.

Invited Lecturer: The McGowan Distinguished Professor Lecture, McGowan Institute, University of Pittsburgh, Pittsburgh, PA, October, 2008.

Invited Lecturer: The International Cartilage Repair Society "Strategic Issues in Cartilage" Meeting, Miami, Florida, October, 2008.

Invited Lecturer: The 9th New Jersey Symposium on Biomaterials Science and Regenerative Medicine. University of New Jersey Medical College, Rutgers, NJ October, 2008.

Invited Lecturer: HEMO2009, 2 plenary lectures, San Paulo, Brazil, November, 2008.

Invited Lecturer: Department of Genetics, Universidade Federal do Rio Grande do Sul, Porto Alegre RS, Brazil, November, 2008.

### 2009

Invited Lecturer: University of Twente, Faculty Science & Technology, Institute for Biomedical Technology. The Netherlands, January, 2009.

Invited Lecturer: Cardiology Grand Rounds; Jefferson Medical School. Philadelphia, PA, January, 2009.

Invited Lecturer: 4th Annual Stem Cell Summit. New York, New York, February, 2009.

Invited Lecturer: Annual American Academy of Orthopaedic Surgeons, Pediatric Orthopaedic Surgeons of North America (Specialty Day: Basic Science Lecture). Las Vegas, NV, February, 2009.

Invited Lecturer: Stamcelinstituut Leuven (SCIL). Brussels, Belgium, April, 2009.

Invited Lecturer: Second Annual Translational Medicine Alliance Forum. Philadelphia, PA, May, 2009,

Organizer: 8th Annual Cell-Based Therapies and Tissue Engineering Short Course (CTTE-2009). Case Western Reserve University, Cleveland, May, 2009.

Invited Lecturer: 3rd International Stem Cell Meeting. Tel Aviv, Israel, June, 2009.

## RESEARCH SUPPORT

Invited Lecturer: Rambam Medical Center, Haifa, Israel, June, 2009.  
 Organizer and Lecturer: Second Annual Business Course in Regenerative Medicine and Entrepreneurism, Case Western Reserve University. Cleveland, Ohio, July, 2009.  
 Organizer and Lecturer: MSC09, Regenerative Medicine & Adult Stem Cell Therapy International Meeting, Cleveland, Ohio, August, 2009.  
 Invited Lecturer: 17th Annual "Advances in Tissue Engineering". Rice University, Houston, TX, August, 2009.  
 Invited Lecturer: Children's Hospital Medical Center of Akron. Akron, Ohio, August, 2009  
 Invited Lecturer: McGill University, Engineering School, Montreal, Canada, September, 2009  
 Invited Lecturer: University of Pretoria, Forestry and Agricultural Biotechnology Institute (FABI). Pretoria, South Africa, September, 2009.  
 Invited Lecturer: Symposium: The Science of Cartilage Repair. Chicago, Illinois, October 2009.  
 Invited Lecturer: IFATS 2009 Conference. Daegu, South Korea, October, 2009.  
 Invited Lecturer: Carnegie Mellon University, Dept. of Biological Sciences. Pittsburgh, PA, November, 2009.

## 2010

Invited Lecturer: Stem Cell World Congress. San Francisco, CA, January 2010.  
 Invited Lecturer: 5<sup>th</sup> Annual Stem Cell Summit, New York, NY, February 2010.  
 Invited Lecturer: Department of Rheumatology, Metrohealth, Cleveland, Ohio, March, 2010.  
 Invited Lecturer: Veterinary and Regenerative Medicine, Santa Ynez, Ca, March 2010.  
 Invited Lecturer: OrthoIndy Journal Club: Indianapolis, IN, March 2010.  
 Organizer: 9th Annual Cell-Based Therapies and Tissue Engineering Short Course (CTTE-2009). Case Western Reserve University, Cleveland, May, 2010.  
 Organizer and Lecturer: Third Annual Business Education Course: The Business of Regenerative Medicine: From Stem Cells to the Market Place, Case Western Reserve University. Cleveland, Ohio, July, 2010.  
 Organizer and Lecturer: MSC09, Regenerative Medicine & Adult Stem Cell Therapy International Meeting, Cleveland, Ohio, August, 2010.  
 Invited Lecturer: 18<sup>th</sup> Annual Tissue Engineering Course, Rice University, August, 2010.  
 Invited Lecturer: V Brazilian Congress on Stem Cells and Cell Therapy, Gramado, RS, Brazil, September 2010  
 Invited Lecturer: National Institute of Science and Technology for Stem Cells and Cell Therapy, Ribeirão Preto, Brazil, September 2010.  
 Invited Lecturer: Butantan Institute, São Paulo-SP, Brazil, September, 2010  
 Invited Lecturer: 2010 World Stem Cell Summit, Detroit, MI, October 2010  
 Invited Lecturer: GE Global Research Cell Manufacturing 2010 Symposium, Niskayuna, NY , October 2010  
 Invited Lecturer: 10<sup>th</sup> New Jersey Symposium on Biomaterials Science, New Brunswick, NJ, October 2010

## RESEARCH SUPPORT

### PAST SUPPORT (as Principal Investigator)

#### National Institutes of Health

<b>HD-07209</b> ; May 1974 through May 1977 .....	\$120,000
<b>AM-17110</b> ; Program Project; September 1973 through September 1979.....	\$ 13,000/annum
<b>DE-72403</b> ; July 1977 through July 1980.....	\$ 51,000
<b>HD-13016</b> ; October 1979 through 1982.....	\$ 38,000/annum
<b>GM-25743</b> ; EM Equipment Grant 1980-1983 .....	\$150,000
<b>AG-02921</b> ; Program Project; 1982 through July 1992.....	\$250,000/annum
<b>DE-04008</b> ; July 1978 through February 1995 .....	\$120,000/annum
<b>AR-40990</b> ; February 1992 through January 1998 .....	\$139,000/annum
<b>AG-11331</b> ; June 1992 through May 1998.....	\$210,000/annum
<b>AR37726</b> ; December 1989 through November 1999 .....	\$336,768
<b>AG08932</b> ; October 1989 through November 1999 .....	\$250,742
<b>DE07220</b> ; March 1993 to February 1998 (June 2001 to May 2003) .....	\$244,004
<b>T32-AG00105-20</b> Cellular and Molecular Aging Training Grant Originally funded in 1984, now through April 2006.....	\$215,000/annum
<b>T32 GM-085056</b> ; Training Grant in Cellular and Molecular Biology; Co-Principal Investigator; July 1975 through 1991.	
<b>T32 AG-00105</b> (AI Caplan, P.I.); "Cellular and Molecular Aging Training Grant;" 5% effort; July 1995 to April 2000 (April 2002 to April 2005)....	\$214,850
(originally funded in 1984)	

**RESEARCH SUPPORT**

**R01-DE13740** (D Dean, P.I., AI Caplan, Co-P.I.) "Strength and Resorption of Biodegradable Skull Implants" 5% effort, February 2002 to January 2005).

**R01-AR48316-01** (AI Caplan, PI, JE Dennis, Co-PI) "Targeted Progenitor Cell Engraftment;" 20% effort September 2001 through July 2006.....\$237,500/annum

**R01-AR049785** (JE Dennis, PI, AI Caplan Co-PI) "Targeted Cellular Repair of Articular Cartilage" June 2004 through May 2009.....\$41,695

**R01-DE015322-01A1** (JE Dennis, PI, AI Caplan Co-PI) "Tissue Engineering of Cartilage Subtypes" August 2004 through July 2009 .....\$1,816,875

**Muscular Dystrophy Association**

January 1975 through July 1996:  
Yearly grants of ..... \$16,000-\$65,000

**Osiris Therapeutics, Inc.:**

"Metabolic Bone/Joint Disease" January 1995 to July 1999 (yearly grants of \$100,000 to \$200,000).

**Veterans Administration** (University of Cincinnati); "Cell-Assisted Tendon

Repair with Aging;" (August, 1998 to July, 1999)..... \$15,500

**Electric Power Research Institute Inc.**

**EPRI/UBP900424** "Biomimetic Approaches to New Designs for Brittle Laminates;" with Dr. Arthur Heuer (July, 1996 to Dec. 1999 .....\$724,019

**Department of Energy**

Through Battelle Pacific Northwest Laboratories, an RFP to the Skeletal Research Center; "Development of New Ceramic/Polymer Composites." Co-Principal Investigator with Dr. Arthur Heuer; July 1, 1988 to September 30, 1991 (with four CWRU laboratories).....\$595,000

**National Science Foundation**

1970 through June 1973.....\$ 38,000  
**DCM76-23672**; July 1977 through December 1979 .....\$ 60,000

**American Cancer Society**

1971 through June 1973.....\$ 62,500  
**VC-162**; July 1974 through July 1976.....\$ 80,000

**National Foundation (March of Dimes)**

**1-401**; July 1975 through July 1981 .....\$210,000

**The Kroc Foundation**

July 1, 1982 through June 30, 1984 .....\$ 80,000  
Endowment Gift for Arthritis Research (with Dr. Roland Moskowitz)  
Lectureship and travel support; April 1985 .....\$ 50,000

**Anna Fuller Fund for Cancer Research**

1970 through September 1973.....\$ 17,000

**BARD**

U.S.-Israel Binational Agricultural Research and Development Fund  
Project No. IS-2679-96; "Extracellular Matrix Molecules of the Eggshell as Related to Eggshell Quality;" (June, 1997 to June 2000).....\$155,000

**PAST INDUSTRIAL SUPPORT**

Genentech, Inc.; Syntex, Inc.; Robapharm, Inc.; Marion Merrill Dow, Inc.; DePuy, Inc.; Zimmer, Inc.; Kourion Therapeutics, Inc.; Fidia Advanced Biopolymers; BioMimetic Therapeutics, Inc.

**PRESENT SUPPORT (2009)**

**RESEARCH SUPPORT**  
**NATIONAL INSTITUTES OF HEALTH**

<b>R01-DE015322-01A1</b> (JE Dennis, PI, AI Caplan Co-PI) "Tissue Engineering of Cartilage Subtypes" August 2004 through July 2010 .....	\$1,816,875
<b>R01-AG021542-01A2</b> (AI Caplan, PI, DA Carrino Co-PI) "A Window into the Aging Process: Skin Proteoglycans". July 2005 through June 2010 .....	\$1,912,500
<b>R01-AR050208-01</b> (JF Welter, PI, AI Caplan Investigator) "Engineering cartilage; an approach to joint repair" April 2005 through March 2010. ....	\$15,000/Yr.
<b>R01-DE016887</b> (J Elisseff, AI Caplan Investigator) "Tissue Engineering in Congenital Craniofacial Defects" July 2007 through May 2011. ....	\$25,000/Yr.
<b>R01-DE13740</b> (D Dean, PI, AI Caplan Investigator) "Strength and Resorption of Biodegradable Skull Implants" July 2007 through May 31, 2012. ....	\$28,000/Yr.
<b>P01-AR053622</b> (AI Caplan, PI, L Solchaga, Co-PI) Program Project Grant Project II Tissue Engineered Cartilage Repair. August 15, 2008 through July 31, 2012.....	\$135,246
<b>P01-AR053622</b> (AI Caplan, PI, V. Goldberg Co-PI) Program Project Grant Core A Tissue Engineered Cartilage Repair. August 15, 2008 through July 31, 2012.....	\$83,844
<b>TECH09-006</b> (AI Caplan, PD) "Treatment of Acute and Chronic Wounds with Tissue Engineering Strategies" August 2008 through June 2011.....	\$107,190
<b>S1072764</b> (AI Caplan, PD) Armed Forces Institute for Regenerative Medicine (AFIRM) March 2008 through June 2010.....	\$302,562

**STATE OF OHIO**

Clinical Tissue Engineering Center (CTEC) (AI Caplan, Co-PI) BRTT State of Ohio. August 2008 through June 2011. ....	\$50,000
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**OTHER RESEARCH SUPPORT**

L. David and E. Virginia Baldwin Program for Cell Therapy October, 2007 to Present ....	\$1,303,500
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**GRADUATE STUDENTS, POSTDOCTORAL FELLOWS AND OTHER PROFESSIONALS**

**PAST**

- 1. James H. Kimura**, Ph.D.; Graduate Student, degree 1976; was Professor of Orthopedics, Joint and Bone Center, Henry Ford Hospital until 2002, now retired, Detroit, Michigan.
- 2. Martin J. Rosenberg**, Ph.D.; Postdoctoral Fellow, 1972-1974; now Executive Officer, Department of Biology, Case Western Reserve University, Cleveland, Ohio.
- 3. Jeffrey Saffitz**, M.S., Ph.D., M.D.; Graduate Student, degree 1978; now Professor, Pathology Department, Beth Israel Deaconess Medical Center, Harvard Medical School, Boston, MA.
- 4. Anna Palka**, M.S.; Graduate Student, degree 1977; was a Research Technician, National Institutes of Health, Bethesda, Maryland.
- 5. Philip Osdoby**, Ph.D.; Graduate Student, degree 1978/Arthritis Foundation Fellow 1979-1981; now Professor, Department of Biological Science, Washington University, St. Louis, Missouri.
- 6. Charles P. Ordahl**; Postdoctoral Fellow, 1975-1978; now Professor, Department of Anatomy, University of California School of Medicine, San Francisco, California.
- 7. Karen Glasier**; Postdoctoral Fellow, 1977-1979; now Pharmaceutical Company Representative, Cleveland, Ohio.
- 8. David A. Carrino**, Ph.D.; Postdoctoral Fellow, 1979-1980; now Senior Research Associate, Department of Biology, Case Western Reserve University, Cleveland, Ohio.
- 9. Gail Yander**, Ph.D.; Postdoctoral Fellow, 1979-1980; was Researcher, Eastman Kodak Company, Rochester, New York.
- 10. Mary C. Martini**, M.S.; Graduate Student, 1980; now in private medical practice and affiliate of University Medical Center, Pittsburgh, Pennsylvania.
- 11. Hue-Lee Kaung**, Ph.D.; sabbatical Visiting Professor, 1980-1981; now in Department of Pediatrics, Case Western Reserve University, Cleveland, Ohio.
- 12. Larry W. Fisher**, Ph.D.; Postdoctoral Fellow, 1980-1981; now Staff Scientist at National Institutes of Health, Bethesda, Maryland.
- 13. Susan J. Hunter**, Ph.D.; Postdoctoral Fellow, 1980-1981; now Professor, Department of Zoology, University of Maine, Orono, Maine.

**COLLABORATIVE FACULTY- Continued**

14. **Jeffrey A. MacCabe**, Ph.D.; sabbatical Visiting Professor, June-September 1981; now Professor, Department of Zoology, University of Tennessee, Knoxville, Tennessee.
15. **Barry W. Cherney**, Ph.D.; Graduate Student, degree 1984; was Staff Scientist, FDA, Washington, D.C.
16. **Zvi Nevo**, Ph.D.; sabbatical Visiting Professor, July-October 1983; now Professor and Chair, Department of Chemical Pathology, Tel-Aviv University, Israel.
17. **Gerry Beaudoin**, Ph.D.; Research Associate, 1982-1984; was Staff Scientist, Avery Corporation.
18. **Ronald J. Midura**, Ph.D.; Graduate Student, degree 1984; now Staff Scientist, Section of Musculoskeletal Biology, Dept. of Biomedical Eng., The Cleveland Clinic Foundation, Cleveland, Ohio.
19. **Deborah E. Hall**, Ph.D.; Graduate Student, degree 1985; was Research Scientist, Department of Anatomy, University of California at San Francisco, San Francisco, California; now free-lance writer.
20. **Michael Weitzhandler**, Ph.D.; Graduate Student, degree 1985; was Research Scientist, Dionex Corporation, Sunnyvale, California.
21. **Carol Cooper**, Ph.D., M.D.; Graduate Student, degree 1985; was Ophthalmologist, Shokoohi Eye Center, Midland, Michigan .
22. **Ellen J. Matzkin**, M.D.; Postdoctoral Fellow, 1985-1986; now in private medical practice in New York.
23. **Uri Oron**, Ph.D.; sabbatical, 1985-1986; now Professor in Zoology at Tel-Aviv University, Tel-Aviv, Israel.
24. **Stephen E. Haynesworth**, Ph.D.; Graduate Student, degree 1987 (1988-1992 as Senior Research Associate); now Associate Professor and Associate Dean, College of Arts and Sciences, Department of Biology, Case Western Reserve University, Cleveland, Ohio.
25. **Hajime Ohgushi**, M.D.; Postdoctoral Fellow, 1985-1987; now Team Leader & Research Head, Tissue Engineering Research Center, Amagasaki City, Hyogo, Japan
26. **David G. Pechak**, Ph.D.; Postdoctoral Fellow/Senior Research Associate, 1981-1987; now Research Scientist, Kraft Foods, Chicago, Illinois.
27. **Mary J. Kujawa**, Ph.D., M.D.; Postdoctoral Fellow, 1983-1987; now Psychiatry, Atlanta, Georgia.
28. **Terry Rabinowitz**, D.D.S., M.D.; Visiting Assistant Professor, 1983-1986; now Associate Professor of Psychiatry, Fletcher Allen Healthcare, Burlington, VT.
29. **Glenn T. Syftestad**, Ph.D.; Postdoctoral Fellow, Research Associate/Research Scientist, 1981-1987; was Associate Professor, Department of Orthopaedics, University of California, Davis, California.
30. **Paul A. Lucas**, Ph.D.; Postdoctoral Fellow, 1984-1987; now Director of Orthopaedic Research, Department of Orthopaedics, New York Medical College, Val Halla, New York.
31. **Henry E. Young**, Ph.D.; Postdoctoral Fellow, 1983-1987; now Professor, Mercer Medical School, Macon, Georgia.
32. **Danny Gazit**, Ph.D., D.D.S.; CIBA Bursury, 1987; now Professor at Hebrew University/Hadassah Medical Center, Jerusalem, Israel.
33. **Samuel Itay**, M.D.; Visiting Scientist, 1986-1988; was Department of Orthopaedics, Beilinson Hospital, Petach Tikva, Israel.
34. **Jun Goshima**, M.D.; Visiting Scientist, 1987-1989; was Assistant Professor, Department of Orthopaedics, Nara Medical University, Nara, Japan.
35. **Haruhiko Nakahara**, M.D.; Visiting Scientist, 1987-1989; was Department of Orthopaedics, Osaka University Medical School, Osaka, Japan.
36. **James H. Reese**, Ph.D.; Senior Research Associate, 1986-1989; was Senior Research Associate, Medical College of Ohio, Toledo, Ohio.
37. **Kazuo Watanabe**, Ph.D.; sabbatical Visiting Scientist, 1989-1990; now Professor, Department of Zoology, Hiroshima University, Hiroshima, Japan.
38. **Scott P. Bruder**, Ph.D.; M.D./Ph.D. Graduate Student, 1987-1990; now Sr. Vice President and Chief Technology Officer BD, Franklin Lakes, NJ.
39. **Marlene Willen**, M.D.; Postdoctoral Fellow, 1989-1990; was Dermatology Metrohealth Medical Center, Cleveland, Ohio.
40. **Naoto Ozawa**, M.D.; Visiting Scientist, 1990-1991; was Orthopaedic Surgeon, Yokohama City University, Yokohama, Japan.
41. **Tatsuhiko Goto**, M.D.; Visiting Scientist, 1989-1991; now Orthopaedic Surgeon and Associate Professor, National Defense Medical School, Tokyo, Japan.
42. **Osamu Nakamura**, Ph.D.; Visiting Scientist, 1989-1991; now Div. of Function. Mat. Sc. Kyushu Nat'l Indus. Res. Inst., Tosu Saga, Japan.
43. **Mohamed Rahima**, D.D.S.; collaborative Researcher, 1988-91; now in private practice, Chicago, Illinois.
44. **Stephen J. Pineda**, M.D.; Research Fellow, 1990-91; now Orthopaedic Surgery, University of Maryland Hospital, Baltimore, Maryland.

**COLLABORATIVE FACULTY- Continued**

45. **Jose Luis Arias**, D.V.M.; sabbatical Visiting Scientist, 1989-1991; now Professor, School of Veterinary Science, University of Chile, Santiago, Chile.
46. **Linan Dong**, D.D.S.; Visiting Scientist, 1990-1991; Beijing Medical University, Beijing, People's Republic of China.
47. **Maria Soledad Fernandez**; visiting master's-degree candidate, 1989-1991; now Associate Professor at University of Chile, Santiago, Chile.
48. **Anne E. Linton**, M.D.; Research Fellow/Orthopaedic Surgery Resident, 1991-1992; was Addiction Psychiatry, Oregon Health Sciences University, Portland, Oregon.
49. **Shigeyuki Wakitani**, M.D.; Visiting Scientist, 1990-1992; now Associate Professor/Orthopaedic Surgeon, Osaka University Medical School, Osaka, Japan.
50. **Iri Liebergall**, M.D., Visiting Scientist, 1991-1992; now Professor of Orthopaedic Surgery, Hebrew University, Jerusalem, Israel.
51. **Juan Pablo Rodriguez**, Ph.D.; Postdoctoral Fellow, 1991-1992; now Associate Professor, University of Chile, Santiago, Chile.
52. **Richard F. Drushel**, Ph.D.; Graduate Student, 1987-1992; now Instructor, Department of Biology, Case Western Reserve University, Cleveland, Ohio.
53. **Toshihiro Sugihara**, M.D., Ph.D.; Visiting Scientist, 1991-1993; now Assistant Professor, St. Marianna University, Kawasaki, Japan.
54. **Tomoyuki Saito**, M.D., Visiting Scientist, 1991-1993; now Professor and Director, Department of Orthopaedic Surgery, Yokohama City University, Yokohama City, Japan.
55. **Yu Mochizuki**, M.D., Ph.D.; Visiting Scientist, 1991-1993; Surgeon, Department of Orthopaedics, Hiroshima University Hiroshima, Japan.
56. **Sara Sarig**, Ph.D., Sabbatical/Visiting Professor, 1992-1993; Professor, The Hebrew University of Jerusalem, Jerusalem, Israel (deceased).
57. **Bruce Greene**, M.D., Research Fellow and Resident/Department of Orthopaedics, 1992-1993; now in private practice, Ithaca, New York.
58. **Randell G. Young**, D.V.M.; Postdoctoral Fellow/Research Fellow (surgical models), 1989-1993; now Manager, Preclinical Studies, Osiris Therapeutics, Inc., Baltimore, Maryland.
59. **Felix Ma**, Undergraduate Student, 1991-1994; now Resident, Hennepin County Medical Center, Minneapolis, Minnesota.
60. **Mehrun Elyaderani**, M.D., Research Fellow, 1993-1995; was Department of Orthopaedics, University Hospitals of Cleveland, Cleveland, Ohio.
61. **David J. Fink**, Ph.D., Adjunct Professor and Consultant, 1991-1995; was CEO/President of Biotech startup, Baltimore, Maryland.
62. **Pierre Cassiede**, Visiting Scholar, 1991-1995; now Laboratoire de recherche sur les matériaux d'intérêt biologique, Faculté de chirurgie dentaire. Nante, France.
63. **Leona M. Mann**, D.D.S., Graduate Student/Research Fellow, 1993-1995; now in private practice, Atlanta, GA.
64. **Christopher Walsh**, M.D., Postdoctoral Fellow, 1994-1995; was in Practice, Department of Orthopaedics, University Hospitals of Cleveland, Cleveland, Ohio.
65. **Kristina Siddall**, Undergraduate, CWRU, Summer 1994.
66. **Lukasz Curylo**, M.D., Postdoctoral Fellow, 1995-96, was Resident, Department of Orthopaedic, University Hospitals of Cleveland, Cleveland, Ohio.
67. **Glen Feltham**, M.D., Postdoctoral Fellow, 1995-96, was Resident, Department of Orthopaedic, University Hospitals of Cleveland, Cleveland, Ohio.
68. **Frederick Jacquot**, M.D., Visiting Scientist, 1995-96, now Chef de Clinique - Assistant, Department of Orthopaedic Surgery, Hospital Raymond Poincare, Garches France.
69. **Douglas Arm**, Ph.D., Postdoctoral Fellow 1995-96, now Researcher, Interpore Inc, San Diego, CA.
70. **Keigo Hanada**, Ph.D., Visiting Scientist, 1995-97, now Researcher at Kaken Industry, Tokyo, Japan.
71. **Keita Nishimura**, M.D., Visiting Scientist, 1996-97, now Researcher, University of Japan, Tokyo, Japan.
72. **James E. Fleming, Jr.**, M.D.; Graduate Student/Research Fellow, 1991-97, was Resident, Cleveland Clinic Foundation, Cleveland, Ohio.
73. **Traci G. Barthel**, M.D.; Research Fellow, 1996-97, was Resident, University Hospitals, Cleveland, Ohio.
74. **Barbara A. Huibregtse**, D.V.M., Postdoctoral Fellow/Research Associate, 1994-97, now Preclinical Manager, Boston Scientific Corp., Natick, Massachusetts.
75. **Emmanuel K. Konstantakos**, Undergraduate, 1995-1997, now Medical Student, CWRU.
76. **Randell Bateman**, 1997-1998, now resident, University of Minn., Minn, MN.
77. **Antonios Mikos**, Ph.D., Sabbatical/Visiting Professor, 1998, now Professor of Bioengineering and

## **COLLABORATIVE FACULTY- Continued**

Chemical Engineering, Rice University.

78. **Magnus Lundberg**, M.D., Ph.D., Visiting Scientist, 1997-1998, now Attending Physician, University Hospital, Linköping, Sweden.
79. **John Edminson**, Undergraduate Student, CWRU, 1996-1998, now Medical student, CWRU.
80. **Kukuji Yamashita**, D.D.S., Ph.D., Visiting Scientist, 1996-1998, now Associate Professor, First Department of Oral Anatomy, University of Tokushima, School of Dentistry, Tokushima, Japan.
81. **Neil Topham**, M.D., Research Fellow, 1997-1999, now Resident, Plastic Surgery, University Hospitals of Cleveland, Ohio.
82. **Maralyn B. Seavolt**, M.D., Postdoctoral Fellow, 1998-1999, was Resident, Dermatology, Cleveland Clinic Foundation, Cleveland, Ohio.
83. **Andreas Naumann**, M.D., Visiting Scientist, 1999-2000, now staff Doctor/Researcher, Munich, Germany.
84. **Laure Brinon**, Ph.D., Visiting Researcher, 2000-2001, now Project Manager, Dermal and Transdermal Systems. ETHYMED, Massy, France.
85. **Enrico Tognana**, Ph.D., Visiting Researcher, 2001, now Project Manager, Fidia Advanced Biopolymers Srl, Albano Terme, Italy.
86. **Hervé Pigeon**, M.S., Visiting Researcher, 2000-2001, L'Oreal Recherche, France
87. **Tommi Tallheden**, Visiting Graduate Student, 2001-2002, now Göteborg University Faculty.
88. **Brian Drew**, M.D., Postdoctoral Fellow, 2001-2002, now Physician, Ear, Nose and Throat, Minneapolis, MN.
89. **Nir Cohen**, M.D., Visiting Researcher, 2001-2002, now Faculty, Department Orthopaedics, Tel Aviv University; Tel Aviv, Israel.
90. **Konrad Slynarski**, M.D., Visiting Researcher, 2001-2002, now Assistant Professor, Warsaw Poland.
91. **Wa'el Kafienah**, M.D., Visiting Researcher, 2002, now University of Bristol Academic Rheumatology, Bristol, United Kingdom.
92. **Mauro Fiorini**, Visiting Researcher, 2002-2003, now Researcher at Fidia Adv. Biopol., Srl, Albano Terme, Italy.
93. **Russell Wang**, D.D.S., Associate Professor, School of Dentistry, 2000-2003, now Case Western Reserve University, Cleveland, Ohio.
94. **Katsuhiko Nishioka**, M.D., Visiting Researcher, 2001-2004.
95. **Jizong Gao**, M.D., Ph.D., Research Associate 1998-2004, now with Zimmer Corporation, Austin, Texas.
96. **James Dennis**, Ph.D., Sr. Research Associate; 1988-2005, now Assistant Professor Orthopaedics at University Hospitals, Cleveland, Ohio.
97. **In-Hwan Song**, M.D., Ph.D., visiting researcher, South Korea, 2004-2005, now Associate Professor and Chairman Department of Anatomy, School of Medicine Yeungnam University, Daegu, South Korea.
98. **Daphne A. Bascom**, M.D., Ph.D., Assistant Professor Otolaryngology Surgery U.H./CWRU, 2002-2005, now Physician Director, Clinical Transformation, Cleveland Clinic Foundation.
99. **Yu-Han Chang**, Ph.D., visiting researcher, Taiwan, 2004-2006, now Attending Physician, Division of Adult Joint Reconstruction, Department of Orthopaedics, Chang Gung Memorial Hospital, Taipei, Taiwan.
100. **Karthik Karibandi**, BA non-designated graduate student, 2005-2006, now Medical Student.
101. **José A. Andrades**, Ph.D., Professor of Cell Biology University of Malaga, Malaga Spain visiting scientist, 2006.
102. **Andreas Winkel**, Ph.D., Postdoctoral fellow 2006-2007, now Postdoctoral fellow, Department of Prosthetic Dentistry, Hannover Medical School, Hannover, Germany.
103. **James (Jay) Henderson**, Ph.D., postdoctoral fellow, 2004-2008, now Assistance Professor Syracuse University.
104. **Sung-Eun Yang**, M.D., Ph.D., visiting researcher, South Korea, 2007-2008, now Assistant Professor Korean University, Seoul, S. Korea.
105. **Fozia Khan**, Ph.D., visiting researcher, 2008-2009, now Assistant Professor, King Saud University, Riyadh, Kingdom of Saudia Arabia.

## **PRESENT SENIOR RESEARCH ASSOCIATES (as Laboratory Staff), Research Professors and Postdoctoral Fellows**

1. **David A. Carrino**, Ph.D.; proteoglycan biochemistry, 1979-.
2. **Diego Correa**, M.D., Ph.D., rheumatoid arthritis 2009-.
2. **Donald P. Lennon**, D.D.S.; tissue culture, 1979-.
3. **Robert M. Lowe**, M.D., Ph.D., rheumatoid arthritis 2009-.

### **COLLABORATIVE FACULTY- Continued**

4. **J. Michael Sorrell**, Ph.D.; monoclonal antibodies, 1990-.
5. **Luis A. Solchaga**, Ph.D., tissue engineering, 1994-.
6. **Jean F. Welter**, M.D., Ph.D., bioreactors, tissue engineering, 2004-.
7. **Durba Mukhopadhyay**, Ph.D.; cartilage repair/rheumatoid arthritis 2008-.
8. **Hulya Bukulmez**, MD.; rheumatoid arthritis 2008-.

### **GRADUATE STUDENTS**

1. Paul Lin, MD-PhD Candidate, 2005-.
2. Michael Haag, MS Candidate, 2003-.
3. Vance Holt, III Ph.D. Candidate 2008-
4. Jonathan Teets, Medical Student

### **SUPPORT STAFF**

1. Margie Harris, Research Assistant I (tissue culture), 1984-.
2. Marilyn A. Baber, Research Assistant III (monoclonal antibodies), 1984-.
3. Tammie Lee, Department Assistant III, 2007-.
4. Kitsie Penick, Research Assistant I (bioreactors, tissue engineering), 2004-.
5. Sheryl Chow, Research Assistant I, 2005-.

### **COLLABORATIVE FACULTY (Shared Resources)**

1. Victor M. Goldberg, M.D., Department of Orthopaedics (Medical School)
2. Stephen E. Haynesworth, Ph.D., Department of Biology (College of Arts & Sciences)
3. Stanton Gerson, M.D., Department of Medicine, Hematology/Oncology (Medical School)
4. Harihara Baskaran, Ph.D., Chemical Engineering (Engineering)
5. Robert Miller, Ph.D., Neurobiology (Medical School)
6. James E. Dennis, Ph.D., Department of Orthopaedics (Medical School)
7. Nora Singer, M.D., Department of Pediatrics (Medical School)
8. Tracey Bonfield, Ph.D., Pulmonary, Pediatrics (RBC)

### **REVIEWER and EDITOR (\*)**

Developmental Biology, Science

Journal of Bone and Joint Surgery, Tissue and Cell

Journal of Cell Biology, Bone

Journal of Craniofacial Genetics, Connective Tissue Research Development

Clinical Orthopaedics and Related Research, Journal of Biomaterials Research

Cell Physiology, Experimental Cell Research

Differentiation, Journal of Biological Chemistry

Journal of Orthopaedic Research, Tissue Engineering\*

Cell Transplantation, Developmental Dynamics

Tissue Engineering and Regenerative Medicine (Editorial Board)

### **REVIEWER and GRANTING AGENCIES**

National Science Foundation (ad hoc)

National Institutes of Health (ad hoc and site visits)

Osteoporosis Foundation

Binational Foundation (Israeli-National Science Fnd)

National Foundation/March of Dimes)

Veterans Administration (ad hoc)

### **ADVISORY BOARDS**

BioMedical Materials International Scientific Advisory Board. Mijdrecht, The Netherlands.

External Advisory Board of The Stem Cell Institute in Leuven. Leuven, The Netherlands.

Advanced BioHealing Soft Tissue Advisory Board, Chicago, Illinois.

External Advisory and Review Board of the South Carolina Project for Organ Biofabrication. Charleston, South Carolina.

## **COLLABORATIVE FACULTY- Continued** **UNIVERSITY COMMITTEES\***

1. University Restructuring and Strategic Planning Committee, 1986-1987.
2. Faculty Senate Research Committee, 1984-1986.
3. Case Institute Strategic Planning Committee, 1985-1986.
4. President's Committee for the Biological Sciences, 1985-1986.
5. Dean's Committee for Tenure and Promotion, 1984-1985.
6. President's Committee for Tenure and Promotion, 1981-1988.
7. University Hospitals Strategic Planning Task Force, 1988.
8. Chairmen's Search Committee, Orthopaedics, University Hospitals, 1989.
9. Provost's Committee on Continuing Education, 1989.
10. Faculty Senate Research Committee, 1990-1993.
11. University Hospitals Biotechnology Committee, 1991-1994.

**\*Committee assignments are no longer recorded (1995-present).**

## **TEACHING EXPERIENCE** (1968-1992; teaching activities no longer recorded.)

### **Case Western Reserve University**

1. Biology Core Curriculum (4th semester), Spring. Course is referred to as "Organismal Biology." I taught about one-third of the lectures where I tried to expose students to the events involved in organ formation so that the rest of the course could cover organ and whole animal physiology.
2. "Theories in Aging": An option course for medical students. I am responsible for one week's material.
3. Seminar in Advanced Developmental Biology. A weekly meeting of undergraduate, graduate and medical students interested in selected research topics in Developmental Biology.
4. Correlated Curriculum in Cellular and Molecular Biology. A year-long multidisciplinary graduate course which was taken by all of the student in the Cellular and Molecular Biology Program plus other incoming graduate students. This course was: 7 contact hours/week and had 25 to 45 graduate students from all of the preclinical departments of the Medical School and several departments from the undergraduate school. I have given lectures on Chromatin and Connective Tissue Biochemistry and Molecular Development.
5. Initiated an introductory Biology course designed for engineering and science students called, "Biological Molecules." This course attempts to introduce basic concepts in Biology (evolution, genetics, etc.) by discussing the biological molecules involved. For example, all of the principles of evolution can be brought forth in discussing the primary structure of hemoglobins or cytochrome c. Previously given every Fall; 3 credit hours with approximately 40 to 50 lectures and 50 to 100 students. No longer offered.
6. "Developmental Biology." Basic events from gametogenesis to organogenesis are covered in this 3 credit hour, 40 to 50 lecture course attended by 40 to 100 students. No longer offered.
7. Developmental Biology Laboratory: Twelve separate weekly presentations covering development in sea urchins, chick and frog with emphasis on experimental embryology. The course, as now organized, stresses the molecular biology of development. Two credits, two sections, 24 students each. No longer offered.
8. "Cell Biology": Gave several lectures in the department's required sophomore level Cell Biology Course primarily in the areas of energy metabolism from a structural and biochemical standpoint and chromatin structure and chemistry.
9. "Cell Biology Laboratory": I have given one or two exercises per year (usually in the area of cell fractionation or mitochondrial function). Two credits, 3 sections, 20 students each.
10. "Freshman Special Studies": During the Spring of 1970 and 1971, I offered a course in this unique Freshman Special Studies program which involved a modification of Herman Epstein's "Biology for Non-Science Majors." Three credit hours, 40 to 50 one hour meetings, 20 students. No longer offered.
11. Various graduate and medical school lectures, including areas in Developmental Cell and Molecular Biology.

### **Brandeis University**

Taught section of "Biology for Non-Science Majors." An experimental course attempting to expose non-science majors to scientific exploration by using research publications as teaching tools.

**TEACHING EXPERIENCE**-continued

**REFERENCES FURNISHED UPON REQUEST**