

## CURRICULUM VITAE

**MARIO RENATO CAPECCHI** Professor  
Date and Place of Birth: October 6, 1937 - Verona, Italy  
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### Degrees:

B.S. Antioch College, Yellow Springs, Ohio, 1961, Chemistry and Physics  
Ph.D. Harvard University, Cambridge, Massachusetts, 1967, Biophysics

### Positions Held:

1969-1971 Assistant Professor, Harvard Medical School  
1971-1973 Associate Professor, Harvard Medical School  
1973-present Professor of Biology, University of Utah  
1982-present Adjunct Professor of Oncological Sciences, Division of Molecular Biology and Genetics, University of Utah School of Medicine  
1988-present Investigator of the Howard Hughes Medical Institute  
1989-present Professor of Human Genetics, University of Utah School of Medicine  
2002-present Co-Chairman of the Department of Human Genetics, University of Utah School of Medicine

### Honors and Awards:

Junior Fellow of the Society of Fellows, Harvard University, 1967-69  
American Chemical Society Award in Biochemistry, 1969  
Established Investigator of the American Heart Association, 1969-72  
America's Ten Outstanding Young Men Award, 1971  
National Institutes of Health Career Development Award, 1972-74  
American Cancer Society Faculty Research Award, 1974-79  
Taught Cold Spring Harbor Summer Course on Microinjection and DNA Transfection, 1984, 1985  
Chairman of the Gordon Conference on Molecular Genetics, 1986  
Distinguished Research Award, University of Utah, 1987  
Chairman of Banbury Conference on Developmental Genetics, Cold Spring Harbor, 1989  
Member of the National Academy of Sciences, 1991-present  
Recipient of NIH MERIT grant award, 1992 to 2001  
Recipient of the Fifth Annual Bristol-Myers Squibb Award for Distinguished Achievement in Neuroscience Research, 1992  
Recipient of the 1993 Gairdner Foundation International Award for Achievements in Medical Science  
Distinguished Professor of Human Genetics and Biology, University of Utah, 1993-present  
Recipient of the 1994 General Motors Corporation's Alfred P. Sloan Jr. Prize for Outstanding Basic Science Contributions to Cancer Research  
Recipient of the 1996 Molecular Bioanalytics Prize, Germany

Laureate of the 1996 Kyoto Prize in Basic Sciences  
Recipient of the 1997 Franklin Medal for Advancing Our Knowledge of the Physical Sciences  
Feodor Lynen Lectureship, 1998 Miami Biosymposium  
Recipient of the 1998 Rosenblatt Prize for Excellence  
Recipient of the 1998 Baxter Award for Distinguished Research in the Biomedical Sciences, Association of American Medical Colleges  
Helen Lowe Bamberger Colby and John E. Bamberger Presidential Endowed Chair in the Health Sciences Center, University of Utah, 1999  
Phi Kappa Phi National Honor Society, 1999  
Lecturer in the Life Sciences for the Collège de France, 1999-2000  
Recipient of the 2000 Horace Mann Distinguished Alumni Award, Antioch College  
Recipient of the 2000 Premio Phoenix-Anni Verdi for Genetic Research Award, Italy  
Recipient of the 33<sup>rd</sup> Jiménez-Díaz Prize for Contributions to Medical Genetics, Spain, 2001  
Recipient of the 2001 Pioneers of Progress Award  
Recipient of the 2001 Albert Lasker Award for Basic Medical Research  
Elected to the rank of Fellow of the American Association for the Advancement of Science, 2001  
Recipient of the State of Utah Governor's Science and Technology Award, 2002  
Laureate of the 2001 National Medal of Science  
Recipient of NIH MERIT grant award, 2002 to 2011  
Recipient of the 2002 John Scott Medal Award  
Recipient of the 2002 Shaul and Meira Massry Foundation Prize  
Elected to the European Academy of Sciences, 2002  
Recipient of the 2003 Pezcoller Foundation-AACR International Award for Cancer Research  
Recipient of the 2002/03 Wolf Prize in Medicine  
Recipient of an Honorary Degree of Doctor of Medicine, University of Florence School of Medicine, Italy, 2004  
Recipient of the 2005 March of Dimes Prize in Developmental Biology

### **Teaching Responsibilities:**

Biochemistry	Eukaryotic Genetics
Cell Biology	Genetics
Developmental Genetics	Molecular Biology

### **Memberships/Services:**

Member of the American Biochemical Society, 1969-present  
Member of the American Society for Biochemistry and Molecular Biology, 1969-present  
Member of the National Science Foundation Advisory Panel on Genetics, 1975-1980  
Member of the National Institute of Health Advisory Panel on Mammalian Genetics, 1981-85  
Member of the Utah Regional Cancer Center, 1985-present  
Member of the American Association for the Advancement of Science, 1987-present  
Member of the Science Innovation Program Committee, 1991-present  
Member of the American Society for Microbiology, 1994-present  
Charter Fellow of the Molecular Medicine Society, 1994-present  
Member of the New York Academy of Sciences, 1995-2003  
Member of the Advisory Panel for the European Molecular Biology Laboratory, Heidelberg, Germany, 1995-present

Member of the Genetical Society, 1997-2000  
Member of the Society for Developmental Biology, 1997-present  
Member of the International Mammalian Genome Society, 1997-2003  
Member of the Board of Scientific Counselors, NCI, 1997-2001  
Fellow of the American Academy of Microbiology, 1997-present  
Member of the Genetics Society of America, 1998-present  
Honorary and Lifetime Member of the American Society of Hematology, 2000-present  
Member of the American Society for Clinical Investigation, 2001-present  
Member of the Editorial Boards of:  
Somatic Cell and Molecular Biology, 1982-present  
DNA, 1982-present  
Molecular and Cellular Biology, 1985-present  
Bio Essays, 1985-present  
Technique, 1989-present  
Mechanisms of Development, 1990-present  
Neurobiology of Disease, 1994-2000  
Molecular Medicine, 1994-present  
Cell Structure and Function, 1994-present  
Developmental Biology, 1995-2001  
FASEB Journal, 1996-1999  
The inSight Editorial Board (Academic Press), 1998-present  
Proceedings of the National Academy of Sciences, 1998-2000  
Rejuvenation Research, 2004

Reviewer for Cell, Current Biology, Development, Developmental Biology,  
Developmental Dynamics, EMBO Journal, FASEB Journal, Genes and Development,  
Journal of Biological Chemistry, Molecular and Cellular Biology, Nature, Nature  
Genetics, Proceedings of the National Academy of Sciences, Science, Trends in  
Genetics, Trends in Neurosciences

### **Publications:**

- Capecchi, M. R. and G. N. Gussin (1965). Suppression *in vitro*: Identification of a serine-tRNA as a "Nonsense Suppressor." *Science* **149**:417-422.
- Adams, J. M. and M. R. Capecchi (1966). N-formylmethionine-tRNA as the initiator of protein syntheses. *Proc. Natl. Acad. Sci. USA* **55**:147-155.
- Capecchi, M. R. (1966). Initiation of *E. coli* proteins. *Proc. Natl. Acad. Sci. USA* **55**:1517-1524.
- Capecchi, M. R. (1966). Cell-free protein synthesis programmed with R17 RNA: Identification of two phage proteins. *J. Mol. Biol.* **21**:173-193.
- Bergquist, P. L. and M. R. Capecchi (1966). Fractionation of a suppressor tRNA. *J. Mol. Biol.* **19**:202-206.
- Gussin, G. N., M. R. Capecchi, J. M. Adams, J. E. Argetsinger, J. Tooze, K. Weber and J. D. Watson (1966). Protein synthesis directed by RNA phage messengers. *Cold Spring Harbor Symp. Quant. Biol.* **31**:257-271.

**Publications:** (cont'd)

- Capecchi, M. R. (1967). Polycistronic messenger RNA and the phenomenon of suppression, BBA Library. In *Regulation of Nucleic Acid and Protein Synthesis* (V. V. Konigsberger and L. Bosch, Ed.), Vol. 10, pp. 243-258. Amsterdam: Elsevier Publishing Co.
- Capecchi, M. R. (1967). A rapid assay for polypeptide chain termination. *Biophys. Res. Comm.* **28**:773-778.
- Capecchi, M. R. (1967). Polypeptide chain termination *in vitro*: Isolation of a release factor. *Proc. Natl. Acad. Sci. USA* **58**:1144-1151.
- Capecchi, M. R. (1967). Polarity *in vitro*. *J. Mol. Biol.* **30**:213-217.
- Capecchi, M. R. and H. A. Klein (1969). Characterization of three proteins involved in polypeptide chain termination. *Cold Spring Harbor Symp. Quant. Biol.* **28**:469-477.
- Capecchi, M. R. and H. A. Klein (1970). Release factors mediating termination of complete proteins. *Nature* **26**:1029-1033.
- Klein, H. A. and M. R. Capecchi (1971). Polypeptide chain termination, purification of the release factors, R<sub>1</sub> and R<sub>2</sub> from *Escherichia coli*. *J. Biol. Chem.* **246**:1055-1061.
- Sharp, J. D., N. E. Capecchi and M. R. Capecchi (1973). Altered enzymes in drug resistant variants of mammalian tissue culture cells. *Proc. Natl. Acad. Sci. USA* **70**:4732-4736.
- Capecchi, M. R., N. E. Capecchi, S. H. Hughes and G. M. Wahl (1974). Selective degradation of abnormal proteins in mammalian tissue culture cells. *Proc. Natl. Acad. Sci. USA* **71**:4732-4736.
- Hughes, S. H., G. M. Wahl and M. R. Capecchi (1975). Purification and characterization of mouse hypoxanthine-guanine phosphoribosyl transferase. *J. Biol. Chem.* **250**:120-126.
- Wahl, G. M., S. H. Hughes and M. R. Capecchi (1975). Immunological characterization of hypoxanthine-guanine phosphoribosyl transferase mutants of mouse L cells: Evidence for mutations at different loci in the HGPRT gene. *J. Cell Phys.* **85**:307-320.
- Capecchi, M. R., S. H. Hughes and G. M. Wahl (1975). Yeast super suppressors are altered tRNAs capable of translating a nonsense codon *in vitro*. *Cell* **6**:269-277.
- Capecchi, M. R. and R. E. Webster (1975). Bacteriophage RNA as template for *in vitro* protein synthesis. In *RNA Phages* (N. D. Zinder, Ed.). Pp. 279-299. Cold Spring Harbor, New York: Cold Spring Harbor Press.

**Publications:** (cont'd)

- Capecchi, M. R., R. A. V. Haar, N. E. Capecchi and M. M. Sveda (1977). The isolation of a suppressible nonsense mutant in mammalian cells. *Cell* **12**:371-381.
- Capecchi, M. R., R. A. V. Haar, N. E. Capecchi and M. M. Sveda (1977). Molecular approaches to eucaryotic genetic systems. *ICN-UCLA Symposia* **8**:381-398.
- Capecchi, M. R., R. A. V. Haar and M. M. Sveda (1978). Characterization of nonsense mutants in mammalian cells in culture. In *Mutations and tRNA Nonsense Suppressors* (J. E. Celis and J. D. Smith, Eds.). New York: Academic Press.
- Capecchi, M. R. (1980). High efficiency transformation by direct microinjection of DNA into cultured mammalian cells. *Cell* **22**:479-488.
- Folger, K. R., E. A. Wong, G. Wahl and M. R. Capecchi (1982). Patterns of integration of DNA microinjected into cultured mammalian cells: Evidence for homologous recombination between injected plasmid DNA molecules. *Mol. Cell. Biol.* **2**:1372-1387.
- Hudziak, R. M., F. A. Laski, U. L. R. Bhandary, P. A. Sharp and M. R. Capecchi (1982). Establishment of mammalian cell lines containing multiple nonsense mutations and functional suppressor tRNA genes. *Cell* **31**:137-146.
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- Folger, K. R., K. R. Thomas and M. R. Capecchi (1984). Analysis of homologous recombination in cultured mammalian cells. *Cold Spring Harbor Symp. Quant. Biol.* **49**:123-138.
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- Frels, W. I., J. A. Bluestone, R. J. Hodes, M. R. Capecchi and D. S. Singer (1985). Expression of a microinjected porcine class I major histocompatibility complex gene in transgenic mice. *Science* **228**:577-580.

**Publications:** (cont'd)

- Wong, E. A. and M. R. Capecchi (1985). Effects of cell cycle position on transformation by microinjection. *Somat. Cell Mol. Genet.* **11**:45-51.
- Goddard, J. M., J. J. Weiland and M. R. Capecchi (1986). Isolation and characterization of *Caenorhabditis elegans* DNA sequences homologous to the *V-abl* oncogene. *Proc. Natl. Acad. Sci. USA* **83**:2172-2176.
- Thomas, K. R., K. R. Folger and M. R. Capecchi (1986). High frequency targeting of genes to specific sites in the mammalian genome. *Cell* **44**:419-428.
- Wong, E. A. and M. R. Capecchi (1986). Analysis of homologous recombination in cultured mammalian cells in a transient expression and a stable transformation assay. *Somat. Cell Mol. Genet.* **12**:63-72.
- Thomas, K. R., and M. R. Capecchi (1986). Introduction of homologous DNA sequences into mammalian cells induces mutations in the cognate gene. *Nature* **324**:34-38.
- Thomas, K. R. and M. R. Capecchi (1986). Targeting of genes to specific sites in the mammalian genome. *Cold Spring Harbor Symp. Quant. Biol.* **51**:1101-1113.
- Wong, E. A. and M. R. Capecchi (1987). Homologous recombination between coinjected DNA sequences peaks in early to mid-S phase. *Mol. Cell. Biol.* **7**:2294-2295.
- Thomas, K. R. and M. R. Capecchi (1987). Site-directed mutagenesis by gene targeting in mouse embryo-derived stem cells. *Cell* **51**:503-512.
- Mansour, S. L., K. R. Thomas and M. R. Capecchi (1988). Disruption of the proto-oncogene *int-2* in mouse embryo-derived stem cells: A general strategy for targeting mutations to nonselectable genes. *Nature* **336**:348-352.
- Capecchi, M. R. (1989). Altering the genome by homologous recombination. *Science* **244**:1288-1292.
- Capecchi, M. R., K. R. Thomas and S. L. Mansour (1989). Creating mice with specific mutations by gene targeting. In *Molecular Genetics of Early Drosophila and Mouse Development* (M. R. Capecchi, Ed.). Pp. 45-52. Cold Spring Harbor, New York: Cold Spring Harbor Press.
- Capecchi, M. R. (1989). The new mouse genetics: altering the genome by gene targeting. *Trends Genet.* **5**:70-76.
- Mansour, S. L., K. R. Thomas, C. Deng and M. R. Capecchi (1990). Introduction of a *lacZ* reporter gene into the mouse *int-2* locus by homologous recombination. *Proc. Natl. Acad. Sci. USA* **87**:7688-7692.
- Thomas, K. R. and M. R. Capecchi (1990). Targeted disruption of the murine *int-1* proto-oncogene resulting in severe abnormalities in midbrain and cerebellar development. *Nature* **346**:847-850.
- Capecchi, M. R. (1990). Tapping the cellular telephone. *Nature* **344**:105.

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- Capecchi, M. R. (1990). How efficient can you get? *Nature* **348**:109.
- Chisaka, O. and M. R. Capecchi (1991). Regionally restricted developmental defects resulting from targeted disruption of the mouse homeobox gene *hox-1.5*. *Nature* **350**:473-479.
- Thomas, K. R., T. A. Musci, P. E. Neumann and M. R. Capecchi (1991). *Swaying* is a mutant allele of the proto-oncogene *Wnt-1*. *Cell* **67**:969-976.
- Chisaka, O., T. S. Musci and M. R. Capecchi (1992). Developmental defects of the ear, cranial nerves and hindbrain resulting from targeted disruption of the mouse homeobox gene *hox-1.6*. *Nature* **355**:516-520.
- Thomas, K. R., C. Deng and M. R. Capecchi (1992). High-fidelity gene targeting in embryonic stem cells by using sequence replacement vectors. *Mol. Cell. Biol.* **12**:2919-2923.
- Deng, C. and M. R. Capecchi (1992). Reexamination of gene targeting frequency as a function of the extent of homology between the targeting vector and the target locus. *Mol. Cell. Biol.* **12**:3365-3371.
- Mansour, S. L., J. M. Goddard and M. R. Capecchi (1993). Mice homozygous for a targeted disruption of the proto-oncogene *int-2* have developmental defects in the tail and inner ear. *Development* **117**:13-28.
- Deng, C., K. R. Thomas and M. R. Capecchi (1993). Location of crossovers during gene targeting with insertion and replacement vectors. *Mol. Cell. Biol.* **13**:2134-2140.
- Capecchi, M. R. (1993). YACs to the rescue. *Nature* **362**:205-206.
- Carpenter, E. M., J. M. Goddard, O. Chisaka, N. R. Manley and M. R. Capecchi (1993). Loss of *Hoxa-1* (*Hox-1.6*) function results in the reorganization of the murine hindbrain. *Development* **118**:1063-1075.
- Condie, B. G. and M. R. Capecchi (1993). Mice homozygous for a targeted disruption of *Hoxd-3* (*Hox-4.1*) exhibit anterior transformations of the first and second cervical vertebrae, the atlas and the axis. *Development* **119**:579-595.
- Capecchi, M. R. (1994). Targeted gene replacement. *Sci. Am.* **270**:54-61.
- Kostic, D. and M. R. Capecchi (1994). Targeted disruptions of the murine *hoxa-4* and *hoxa-6* genes result in homeotic transformations of components of the vertebral column. *Mech. Dev.* **46**:231-247.
- Davis, A. P. and M. R. Capecchi (1994). Axial homeosis and appendicular skeleton defects in mice with targeted disruption of *hoxd-11*. *Development* **120**:2187-2198.

**Publications:** (cont'd)

- Condie, B. G. and M. R. Capecchi (1994). Mice with targeted disruptions in the paralogous genes *hoxa-3* and *hoxd-3* reveal synergistic interactions. *Nature* **370**:304-307.
- Spyropoulos, D. D. and M. R. Capecchi (1994). Targeted disruption of the *even-skipped* gene, *evx1*, causes early postimplantation lethality of the mouse conceptus. *Genes Dev.* **8**:1949-1961.
- Rancourt, D. E., T. Tsuzuki and M. R. Capecchi (1995). Genetic interaction between *hoxb-5* and *hoxb-6* is revealed by nonallelic noncomplementation. *Genes Dev.* **9**:108-122.
- Capecchi, M. R. (1995). A personal view of gene targeting. In *Accomplishments in Cancer Research 1994*. (J. G. Fortner and J. E. Rhoads, Ed.) Philadelphia: J. B. Lippincott, pp. 67-78.
- Manley, N.R. and M.R. Capecchi (1995). The role of *hoxa-3* in mouse thymus and thyroid development. *Development* **121**:1989-2003.
- Davis, A.P., D.P. Witte, H.M. Hsieh-Li, S.S. Potter and M.R. Capecchi (1995). Absence of radius and ulna in mice lacking *hoxa-11* and *hoxd-11*. *Nature* **375**:791-796.
- Capecchi, M.R. (1995). The molecular genetic analysis of mouse development. In *Seminars in Developmental Biology*. (M.R. Capecchi, Ed.) London: Academic Press **6**:233-237.
- Zeihner, B.G., E. Eichwald, J. Zabner, J.J. Smith, A.P. Puga, P.B. McCray, Jr., M.R. Capecchi, M.J. Welsh, and K.R. Thomas (1995). A mouse model for the  $\Delta$ -F508 allele of cystic fibrosis. *J. Clin. Invest.* **96**:2051-2064.
- Davis, A.P. and M.R. Capecchi (1996). A mutational analysis of the 5' Hox D genes: Dissection of genetic interactions during limb development in the mouse. *Development* **122**:1175-1185.
- Delort, J.P. and M.R. Capecchi (1996). TAXI/UAS: a molecular switch to control expression of genes *in vivo*. *Hum. Gene Ther.* **7**:809-820.
- Boulet, A.M. and M.R. Capecchi (1996). Targeted disruption of *hoxc-4* causes esophageal defects and vertebral transformations. *Dev. Biol.* **177**:232-249
- Esther, C. R., Jr., T. E. Howard, E. M. Marino, J. M. Goddard, M. R. Capecchi and K. E. Bernstein (1996). Mice lacking angiotensin-converting enzyme have low blood pressure, renal pathology, and reduced male fertility. *Lab. Invest.* **74**:953-965.
- Goddard, J. M., M. Rossel, N. R. Manley and M. R. Capecchi (1996). Mice with targeted disruption of *Hoxb-1* fail to form the motor nucleus of the VIIth nerve. *Development* **122**:3217-3228.
- Barrow, J. R. and M. R. Capecchi (1996). Targeted disruption of the *hoxb-2* locus in mice interferes with expression of *hoxb-1* and *hoxb-4*. *Development* **122**:3817-3828.

**Publications:** (cont'd)

- Esther, C. R., Jr., T. E. Howard, Y. Zhou, M. R. Capecchi, M. B. Marrero and K. E. Bernstein (1996). Lessons from angiotensin-converting enzyme-deficient mice. *Curr. Opin. Nephrol. Hypertens.* **5**:463-467.
- Capecchi, M. R. (1996). Function of homeobox genes in skeletal development. In *Molecular and Developmental Biology of Cartilage*, Vol. 785. (B. de Crombrughe, W. A. Horton, B. R. Olsen, and F. Ramirez, Eds.) *Ann. N. Y. Acad. Sci.* **785**:34-37.
- Chen, F. and M. R. Capecchi (1997). Targeted mutations in *Hoxa-9* and *Hoxb-9* reveal synergistic interactions. *Dev. Biol.* **181**:186-196.
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- Thomas, K. R. and M. R. Capecchi (1997). Recombinant DNA technique and sickle cell anemia research. *Science.* **275**:1404-1405.
- Capecchi, M. R. (1997). The role of *Hox* genes in hindbrain development. In *Molecular and Cellular Approaches to Neural Development*. (W.M. Cowan, T.M. Jessell and S.L. Zipursky, Eds.) New York: Oxford University Press, pp. 334-355.
- Esther, C. R., Jr., E. M. Marino, T. E. Howard, A. Machaud, P. Corvol, M. R. Capecchi and K. E. Bernstein (1997). The critical role of tissue angiotensin-converting enzyme as revealed by gene targeting in mice. *J. Clin. Invest.* **99**:2375-2385.
- Carpenter, E. M., J. M. Goddard, A. P. Davis, T. P. Nguyen and M. R. Capecchi (1997). Targeted disruption of *Hoxd10* affects mouse hindlimb development. *Development* **124**:4505-4514.
- Capecchi, M. R. (1997). *Hox* genes and mammalian development. In *Cold Spring Harbor Symposia on Quantitative Biology: Pattern Formation during Development*. Vol. LXII. Cold Spring Harbor, NY: Cold Spring Harbor Laboratory Press, pp. 273-281.
- Condie, B. C., G. Bain, D. I. Gottlieb and M. R. Capecchi (1997). Cleft palate in mice with a targeted mutation in the  $\gamma$ -aminobutyric acid-producing enzyme glutamic acid decarboxylase 67. *Proc. Natl. Acad. Sci. USA* **94**:11451-11455.
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- Wilder, P. J., D. Kelly, K. Brigman, C. L. Peterson, T. Nowling, Q.-S. Gao, R. D. McComb, M. R. Capecchi and A. Rizzino (1997). Inactivation of the FGF-4 gene in embryonic stem cells alters the growth and/or the survival of their early differentiated progeny. *Dev. Biol.* **192**:614-629.

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- Capecchi, M. R. (1997). The Making of a Scientist. In *Kyoto Prizes and Inamori Grants 1996*. Kyoto: The Inamori Foundation.
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- Barrow, J. R. and M. R. Capecchi (1999). Compensatory defects associated with mutations in *Hoxa1* restore normal palatogenesis to *Hoxa2* mutants. *Development* **126**:5011-5026.
- Rossel, M. and M. R. Capecchi (1999). Mice mutant for both *Hoxa1* and *Hoxb1* show extensive remodeling of the hindbrain and defects in craniofacial development. *Development* **126**:5027-5040.
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- Hashimoto, J., G. Murakami, M. H. Tsugane, O. Chisaka, M. R. Capecchi and T. Ogino (1999). Lumbosacral plexus in *Hoxa9* knockout mice with special reference to

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their nerve variations identified according to whether they were interphenotypic or intergenotypic differences. *Kaibogaku Zasshi* **74**:609-630.

Capecchi, M. R. (2000). Human germline gene therapy: How and why. In *Engineering the Human Germline*. (G. Stock and J. Campbell, Eds.) New York: Oxford University Press, pp. 31-42.

Greer, J. M., J. Puetz, K. R. Thomas and M. R. Capecchi (2000). Maintenance of functional equivalence during paralogous *Hox* gene evolution. *Nature* **403**:661-665.

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