

Carol Cutler Linder Ph.D.
Assistant Professor of Biology
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Teaching Fields

Molecular and Cellular Biology
Genetics
Developmental Biology
Animal Models in Biomedical Research

Courses

Molecular and Cellular Biology (Biol423)
Advanced Cell Biology (LSci640)

General Biology 1 and 2 (Biol211 and Biol212)
Genetics (Biol300)
Animal Structure and Function (Biol302)
Developmental Biology (Biol481)
Adv Topics - Mouse Models in Biomedical Research (LSci620)
Graduate Seminar in Life Sciences (LSci650)
Independent Research and Independent Study
Supervision of senior research projects

Research Interests

Developmental regulation of spermatogenesis
Mouse genetics
Regulation of gene expression
Mouse models for human disease

Description

I am interested in identifying genes and elucidating mechanisms of cellular differentiation. Mouse spermatogenesis provides an ideal model for these investigations. Germ cells in the testes undergo mitotic proliferation, meiotic reduction of chromosome number, and transformation into very specialized cells designed to effectively transmit genetic material to a female egg. We are characterizing two genetic male infertility mutants, *repro27* and *repro29*, using a variety of genetic, cell, and molecular approaches. These include DNA and RNA isolation, PCR, real time PCR, cell culture, DNA sequencing, Western blotting, immunohistochemistry, TUNEL, and histological analysis.

Significance

Identification of genes causing defects in spermatogenesis will increase our understanding of male reproductive biology and in particular the process of male gamete formation (spermatogenesis). This will in turn increase our ability to diagnose and treat male infertility.

Ongoing Research Support

P20 RR-03-010 Arterburn (PI), NM State
NIH/NCRR NM-Idea Networks of Biomedical Research Excellence (www.nminbre.org)
Subproject Award: Gene expression patterns during spermatogenesis

P20MD001104-01 Rivera (PI) NMHU



NIH/NCRR-Research Infrastructure in Minority Institutions;
Subproject Award: *repro27*, a mouse model of male infertility

S09UR016/S2009ur0024 Linder (PI)
Western Alliance to Expand Student Opportunities (WAESO)
Subproject Award: Male Infertility Candidate Genes

Professional Affiliations

American Society of Andrology (*Ad Hoc* reviewer for *Journal of Andrology*, 2008).
Society for the Study of Reproduction
Lab Animal Editorial Board (*Ad Hoc* reviewer).
Sigma Xi Scientific Research Society, NMHU Chapter secretary/treasurer

Research Presentations

Woods JB Griffith D, Mora ML, Lopez A, Bentson LF, **Linder CC**, Lizong R, Griswold M. Positional Cloning and Characterization of C3Fe;B6-*repro29* male infertility mutant mice. American Society for Andrology 33rd Annual Meeting, Albuquerque NM, April 12-15, 2008 (and NMHU Research Day, April 25, 2008).

Nfonsam LE, Bentson LF, Bornstein SA, Handel MA, **Linder CC**. Defective spermatogenesis and differential GOLGA3 expression in C3Fe;B6-*repro27*; American Society for Andrology 33rd Annual Meeting, Albuquerque NM, April 12-15 2008 (and NMHU Research Day, April 25, 2008).

Parson G, Mora ML, Martinez A, Woods JB, Elliot R t, Nelson B, **Linder C**, Helvenston M. The Synthesis and study of a salicinium analog as a possible treatment for breast cancer. NMHU Research Day, April 25, 2008.

Linder CC, Woods JB, Bentson LF, Mora ML. Spermatogenic defects in C3Fe;B6-*repro29* mice cause male-specific infertility. 40th Annual Meeting of the Society for the Study of Reproduction Annual Meeting, San Antonio TX, July 21 - 25, 2007.

Nfonsam LE, Bentson LF, Agbor VA, Agbor NL, Jorgensen SB, Bornstein SA, Handel MA, and **Linder CC**. Differential GOLGA3 expression and defective spermatogenesis in C3Fe;B6-*repro27*. 40th Annual Meeting of the Society for the Study of Reproduction Annual Meeting, San Antonio TX July 21, - 25, 2007.

Bentson LF, Agbor VA, Bornstein SA, Handel MA, **Linder CC**. Mutation in the *Golga3* gene identified in male infertility mouse model with defective spermatogenesis, C3Fe;B6-*repro27*. XIX North American Testis Workshop, Tampa FL, April 18-21, 2007.

Woods JB Bentson LF, Mora ML, **Linder CC**. Defective spermiogenesis in C3Fe;B6-*repro29*, a genetic mouse model of male infertility. XIX North American Testis Workshop, Tampa FL, April 18-21, 2007.

Mora ML, Woods JB, Bentson LF, **Linder CC**. Defective spermiogenesis in C3Fe;B6-*repro29*, a genetic mouse model of male infertility. NM INBRE Annual Meeting, UNM, Albuquerque NM, May 17-19, 2007.

Nfonsam LE, Bentson LF, Agbor VA, Agbor NL, Jorgensen SB, Bornstein SA, Handel MA, and **Linder CC**. Differential GOLGA3 expression and defective spermatogenesis in C3Fe;B6-*repro27*. NM INBRE Annual Meeting, UNM, Albuquerque NM, May 17-19, 2007.

Nfonsam LE, Bentson LF, Agbor VA, Agbor NL, Jorgensen SB, Bornstein SA Handel MA, and **CC Linder**. Differential GOLGA3 expression and defective spermatogenesis in C3Fe;B6-*repro27*. NM Bioinformatics Symposium, Santa Fe NM, March 8, 2007.

Woods JB, Bentson LF, Mora ML, **Linder CC**. Genetic mapping of male infertility mutant mice, C3Fe;B6-*repro29*. NM Bioinformatics Symposium, Santa Fe NM March 8, 2007.

Linder CC. Using Mouse Models - Genetic factors that influence phenotype. Society for the Study of Reproduction Annual Meeting, Omaha NE, July 2006.

Agbor NL, Agbor VA, Sweeney S, Handel MA, Griswold MD, **Linder CC.** Developmental and gene expression profiling during spermatogenesis in a chemically-induced genetic mouse model of infertility (*repro27*). Society for the Study of Reproduction Annual Meeting, Omaha NE, July 2006.

Agbor VA, Agbor NL, **Linder CC.** Spermatogenic defects in *repro27* mice, a genetic mouse model of infertility. Society for the Study of Reproduction Annual Meeting, Omaha NE, July 2006.

Agbor NL, Agbor VA, Sweeney S, Handel MA, Griswold MD, **Linder CC.** Developmental and gene expression profiling during spermatogenesis in a chemically-induced genetic mouse model of infertility (*repro27*). Texas Tech Research Day, February, 2006; NMHU Research Day, April, 2006.

Selected Publications

Currer JM, Witham BA, **Linder CC**, Flurkey K. Chapter 5: selecting a mouse model for research. In: *Handbook on Genetically Standardized JAX[®] Mice, 6th edition*. Currer JM and Flurkey K (eds), Jackson Laboratory Press, Bar Harbor ME.

Currer JM, **Linder CC**, Witham BA, Corrigan J, Davisson MT, Merriam J, Flurkey K. Chapter 3: Categories of laboratory mice: genetic architecture, uses, nomenclature. In: *Handbook on Genetically Standardized JAX[®] Mice, 6th edition*. Currer JM and Flurkey K (eds). Jackson Laboratory Press, Bar Harbor ME.

Linder CC, Witham BA. Appendix X: commonly-used inbred strains and substrains of JAX[®] mice—genes and research applications. In: *Handbook on Genetically Standardized JAX[®] Mice, 6th edition*. Currer JM and Flurkey K (eds), Jackson Laboratory Press, Bar Harbor ME.

Linder CC. 2006. Genetic variables that affect phenotype. *ILAR Journal*, 47:132-140.

Berry ML, **Linder CC.** 2007. Breeding Systems: Considerations, Genetic Fundamentals, Genetic Background, and Strain Types. In: *Mouse in Biomedical Research, 2nd ed Vol 1*. Fox J, Barthold S, Davisson MT, Newcomer C, Quimby F, Smith A (eds.), Elsevier Inc, pp 53-78.

Davisson MT, **Linder CC.** 2004. Historical Foundations. In: *Laboratory Mouse, Handbook of Experimental Animals Series*, Hedrich HJ, Bullock G, Petrusz P (eds.), Elsevier Science, London, UK, . pp 15-21.

Linder CC, Davisson MT. 2004. Strains, Stocks, and Mutant Mice. In: *Laboratory Mouse, Handbook of Experimental Animals Series*, Hedrich HJ, Bullock G, Petrusz P (eds.), Elsevier Science, London, UK, pp 25-44.

Linder CC. 2002. Mouse Nomenclature and Maintenance of Genetically Engineered Mice. *Comp Med* 53:119-125.

Linder CC. 2001. The influence of genetic background on spontaneous and genetically engineered mouse models of complex diseases. *Lab Anim* 30(5):34-9.

Law GL, McGuinness M, **Linder CC**, Griswold MD. 1997. Expression of apolipoprotein E mRNA in the epithelium and interstitium of the testis and the epididymis. *J Androl* 18(1):32-42.

Linder CC, Heckert LL, Goetz TL, Nilson JH, and Griswold MD. 1995. The molecular biology of the FSH receptor. *J Steroid Biochem Mol Biol* 53:215-218.

McGuinness M, Heckert L, Decker G, **Linder CC**, Morales C, Griswold M. 1994. Relationship of a Mouse Sertoli Cell Line (MSC-1) to Normal Mouse Sertoli Cells. *Biol Repro* 51:116-124.

Griswold MD, Heckert L, **Linder CC.** 1995. The molecular biology of the FSH receptor. *J Steroid Biochem Mol Biol* 53:215-218.

Linder CC, Heckert LL, Goetz TL, Griswold MD. 1994. Follicle-stimulating hormone receptor gene promoter activity. *Endocrine* 2:957-966.

Linder CC, Griswold MD. 1993. Stage synchronization in rat seminiferous tubules using vitamin A depletion. *Meth Repro Toxic Acad Press* (Ed. Robert E. Chapin and Jerrold J. Heindel) 95-105.

Treize AEO, **Linder CC**, Grieger D, Thompson EW, Meunier H, Griswold MD, Buchwald M. 1993. CFTR expression is regulated during both the cycle of the seminiferous epithelium and the oestrous cycle of rodents. *Nat Genet* 3(2):157-164.

Sitteri JE, Karl AF, **Linder CC**, Griswold MD. 1992. Testicular synchrony: evaluation and analysis of different protocols. *Biol Repro* 46:284-289.

Linder CC, Heckert LL, Roberts KP, Kim KH, Griswold MD. 1991. Expression of receptors during the cycle of the seminiferous epithelium. In: *The Male Germ Cell: Spermatogonium to Fertilization*. *Ann of NY Acad Sci* 637:313-321.

Research Technician and Lab Manager

- Lisa Bentson, M.S.

Postdoctoral Fellow

- Craig Gifford, Ph.D.

Current Students

- Anita Lopez (graduate)
- Devon Chisholm (undergraduate)
- Ruben Esparza (undergraduate)
- Kelina Powell (undergraduate)
- Mingma Sherpa (undergraduate)
- Rahul Sigdel (undergraduate)

Former Students

- Jennifer Woods, B.S., M.S. (2008)
- Landry Ewongkem Nfonsam, M.S. (2008)
- Daniel Griffith, B.S. (2008)
- Sara Jorgensen, B.S. (2007)
- Larry Agbor, M.S. (2006)
- Valentine Agbor, M.S. (2006)
- Zac Karim B.S. (2006)
- Andrew Garst, B.S. (2006)
- Wassim Basheer, B.S. (2006)