Curriculum Vitae

Michael E. Harris, PhD
Center for RNA Molecular Biology
Department of Biochemistry
Case Western Reserve University School of Medicine
Cleveland, OH 44106
Phone: (216) 368-4779
michael.e.harris@case.edu
http://www.case.edu/med/rnacenter/harris.htm

Education and Academic Appointments:

B.S., (Chemistry) 1986 Florida State University
Ph.D., (Biochemistry) 1992 University of Alabama at Birmingham (thesis advisor Dr. Stephen L. Hajduk)

1992 – 1996 Postdoctoral Fellow, Department of Biology, Indiana University (laboratory of Dr. Norman R. Pace)

1996 – 2002 Assistant Professor, Center for RNA Molecular Biology, Department of Molecular Biology and Microbiology, Case Western Reserve University School of Medicine

2002 – present Associate Professor, Center for RNA Molecular Biology, Department of Biochemistry, Case Western Reserve University School of Medicine

Research Interests:

Mechanisms of catalysis by RNA and protein enzymes

Professional Activities:

Ad Hoc Reviewer:

Biochemistry, Biophysical Journal, Cell, Molecular Cell, EMBO Journal, Journal of Biological Chemistry, Journal of Molecular Biology, Nature, Nature Chemistry, Nature Structural & Molecular Biology, Nucleic Acids Research, Proc. Natl. Acad. Sci. USA, RNA Journal, J Am Chem Soc, Chemistry & Biology, ACS Chemical Biology

Grant Review and Advisory Panels:

1997 – 2000	Reviewer, CWRU / Ireland Cancer Center ACS Pilot study grant review committee
1998 – 2001	External Advisory Panel, Program Project GM-96012, Structural Biology of AIDS Related Proteins
1999 – 2000	Chemistry Instructor, Health Careers Enhancement Program for Minorities
1999 – 2001	Reviewer, American Chemical Society, Petroleum Research Fund
1999 – 2001	Reviewer SUNY Collaborative Incentive Grant Program
2004	Ad Hoc Reviewer, Biochemistry Study Section, NIH
2004 - 2005	Ad Hoc Reviewer Fogarty International Collaborative Grant Program (ICP-1), NIH
2004 - 2005	Ad Hoc Reviewer NRSA Study Section ZGR-1 Genes and Genomes, NIH
2005 – 2009	Member,ICP-1 Study section, International and Collaborative Projects, NIH

2005 – 2009	Reviewer, Biotechnology and Biological Sciences Research Council, UK

University Service:

University Committees:

1998 – 2001	Member, Dept. of Molec. & Micro. Graduate Admissions Committee
1998 – 2002	Member, Biomedical Sciences Training Program (BSTP) Graduate Admissions Committee
2000 – 2001	Section Leader, RNA biosynthesis and processing section, C3MB First year graduate curriculum
2001 – 2006	Faculty Organizer, CWRU School of Medicine Graduate Student Symposium.
2003-2004	SCTL Faculty Scholar, Scholars Collaboration in Teaching and Learning Program.
2005	UCITE Teaching and Learning Scholar, University Center for Innovation in Teaching and Education. http://www.case.edu/provost/UCITE/index.html
2002 – 2007	Section Leader, Genetics, Molecular Biology & Developmental Biology Committee, First year medical education curriculum
2007 – present	Member, Dept of Biochemistry Undergraduate Curriculum Committee
2007 – present	Faculty Advisor, Biomedical Graduate Student Organization http://casemed.case.edu/gradprog/bgso.cfm
2007 – present	Principle Investigator: Cell and Molecular Biology Traning Grant (NIH T32GM008056-25). http://www.case.edu/med/cmbtg/
2007 – present	Academic Advisor, Biomedical Sciences Training Program. http://www.case.edu/med/BSTP/

Teaching:

1997 – present	MBDG First year Medical Teaching Committee
1998 – 2000	C3MB; Cell and Molecular Biology Core Curriculum, (RNA Synthesis and Processing Section Leader)
1999 – 2010	MBIO400; RNA Structure and Function
2000 – 2010	CBIO455; Molecular Biology of RNA
2007 – present	BIOC312/412; Proteins and Enzymes (couse coordinator)
2009 – present	BIOC613 ; Special Topics in Enzyme Kinetics

Trainees:

Current:

Dr. Hong Gu	Postdoctoral Fellow	7/08 – present	
Lindsey Yandek	Graduate student	12/07 – present	
Daniel Kellerman	Graduate student	12/07 – present	
Dr. Frank Campbell	Research Associate	9/97 – present	

Former:

Dr. Eric Christian	Postdoctoral Fellow	7/96 – 12/10	
Dr. Shuming Zhang	Postdoctoral Fellow	7/09 – 9/10	
Lei Sun	Graduate student	1/02 – 7/07	Post Doc, Whitehead Inst.
Xia Guo	Visiting professor	3/05 – 3/06	Prof, Yangzhou Univ., PRC
Nicholas Perrera	Medical Student	3/02 – 3/04	Pediatrician, Mcallen, Texas,
Nicholas Kaye	Graduate student	5/96 – 3/03	Associate Scientist, Athresis
Nathan Zahler	Graduate student	5/98 – 4/04	Project Dir, Carslbad Pharm.
Adam Cassano	Graduate student	5/98 – 12/03	Associate Prof, Drew Univ., NJ

Publications:

Harris ME, Moore DR and Hajduk SL. (1990). Addition of uridines to edited RNAs in trypanosome mitochondria occurs independently of transcription. **J. Biol. Chem.** *265*, 11368-11376.

Harris ME, Böhni R, Schneiderman MH, Ramamurthy L, Schümperli D and Marzluff WF. (1991). Regulation of histone mRNA in the unperturbed cell cycle: evidence suggesting two post-transcriptional steps. **Molec. Cell. Biol.** 5, 2416-2424.

Adler B, Harris ME, Bertrand KI and Hajduk SL. (1991) Modification of *Trypanosoma brucei* mitochondrial rRNA by post-transcriptional 3' polyuridine tail formation. **Molec. Cell. Biol.** *12*, 5878-5884.

Harris ME, Decker C, Sollner-Webb B and Hajduk SL. (1992). Specific cleavage of pre-edited RNAs in extracts from trypanosome mitochondria. **Molec. Cell. Biol.** *6*, 2591-2598.

Hajduk SL, Adler B, Bertrand K, Hager K, Harris ME, Moore D, Priest J and Wood Z. (1992) Molecular biology of african trypanosomes: development of new strategies to combat an old disease. **Am. J. Med. Sci.** *303*, 258-270.

Harris ME and Hajduk SL. (1992). *In vitro* formation of gRNA/mRNA chimeras from synthetic substrate RNAs. **Cell** *68*, 1091-1099.

Gabb HA, Harris ME, Pandey NB, Marzluff WF and Harvey SC. (1992). Molecular modeling to predict the structural and biological effects of mutations in a highly conserved histone mRNA loop sequence. **J. Biomolec. Struc. and Dynam.** *9*, 1119-1130.

Michelotti EF, Harris ME, Adler BK, Torri A and Hajduk SL. (1992). *Trypanosoma brucei* mitochondrial ribosomal RNA synthesis, processing and developmentally regulated expression. **Molec. and Biochem. Parasitol.** *54*, 31-42.

Pollard VW, Harris ME and Hajduk SL. (1992) Native RNA editing complexes from trypanosome mitochondria. **EMBO J** *7*, 4429-4438.

Hajduk SL, Harris ME and Pollard VW. (1993) RNA editing in trypanosome mitochondria. **FASEB J** *7*, 54-63.

Harris ME, Nolan JM, Malhotra A, Brown JW, Harvey SC and Pace NR. (1994) Use of photoaffinity crosslinking and molecular modeling to analyze the global architecture of ribonuclease P RNA. **EMBO J** *13*, 3953-3960.

Frank D, Harris ME and Pace NR. (1994) Rational design of self-cleaving pre-tRNA ribonuclease P RNA conjugates. **Biochemistry** *33*, 10800-10808.

Harris ME and Pace NR. (1995) Identification of phosphates involved in catalysis by the ribozyme RNase P RNA. **RNA** *1*, 210-218.

Piller KJ, Decker CJ, Rusche L, Harris ME, Hajduk SL and Sollner-Webb B. (1995) Editing domains of *Trypanosoma brucei* mitochondrial RNAs identified by secondary structure. **Molec. Cell. Biol.** *15*, 2916-2924.

Harris ME and Pace NR. (1996) Analysis of the tertiary structure of bacterial RNase P RNA. **Molec. Biol. Reports** *22*,115-123.

Harris ME, Kavansev A, Chen J-L and Pace NR (1997). Analysis of the tertiary structure of the ribonuclease P ribozyme-substrate complex by site-specific photoaffinity crosslinking. **RNA** *3*, 561-576.

Harris ME, Frank D and Pace NR (1997). "*Structure and catalytic function of bacterial ribonuclease P RNA*" in RNA Structure and Function R.W. Simons and M. Grunberg-Manago eds., Cold Spring Harbor Laboratory Press. 1997

Chen J-L, Nolan JM, Harris ME and Pace NR. (1998). Comparative photocross-linking analysis of the teriary structures of *Escherichia coli* and *Bacillis subtilis* RNase P RNAs. **EMBO J** *17*, 1515-1525.

Christian EL, McPheeters DS and Harris ME (1998) Identification of individual nucleotides in the bacterial ribonuclease P ribozyme adjacent to the pre-tRNA cleavage site by short-range photocrosslinking. **Biochemistry** 37, 17618-17628.

Siew D, Zahler N, Cassano A, Strobel S and Harris ME. (1999) Identification of individual adenosine chemical groups involved in substrate recognition by the ribonuclase P ribozyme. **Biochemistry** *38*, 1873-1883.

Christian EL and Harris ME. (1999) The track of the pre-tRNA 5' leader sequence in the ribonuclease P ribozyme-substrate complex. **Biochemistry** *38*, 12629-12638.

Harris ME and Christian EL. (1999) Use of circularly permutation and end-modification to position photoaffinity probes for analysis of RNA structure. **Methods** *18*, 51-59.

Christian EL, Kaye NM and Harris ME. (2000) Helix P4 is a divalent metal ion binding site in the conserved core of the ribonuclease P ribozyme. **RNA**. *6*, 511-519.

Campbell FE, Cassano AG, Anderson V and Harris ME. (2002). Pre-steady state and stopped flow fluorescence analysis of *E. coli* RNase III: Insights into mechanism and conformational changes associated with binding and catalysis. **J Molec Biol.** *317*, 21-40.

Kaye NM, Christian EL and Harris ME. (2002). NAIM and site-specific functional group modification analysis of the RNase P ribozyme: Magnesium dependent structure in the P1-P4 multi-helix junction contributes to catalysis. **Biochemistry** *41*, 4533-4545.

Christian EL, Kaye NM and Harris ME. (2002). Evidence for a polynuclear metal ion binding site in the catalytic domain of ribonuclease P RNA. **EMBO J** *21*, 2253-2262.

Cassano AG, Anderson VE and Harris ME. (2002). Evidence for direct attack by hydroxide in phosphodiester hydrolysis. **J. Am. Chem. Soc.** 124(37):10964-5.

Christian EL, Kaye NM, Zahler, NH and Harris ME. (2002). Analysis of substrate recognition by the ribonucleoprotein endonuclease RNase P. **Methods** 28, 307-322.

Kaye NM, Zahler NH, Christian EL and Harris ME. (2002). Conserved helix structure contributes to functional metal ion interactions in the catalytic domain of ribonuclease P RNA. **J. Molec Biol.** 324(3):429-442.

Zahler NH, Christian EL and Harris ME. (2003). Recognition of the 5' leader of pre-tRNA substrates by the active site of ribonuclease P. **RNA**. 9, 734-745.

Harris ME and Christian EL. (2003). Recent insights into the structure and function of the ribonucleoprotein enzyme RNase P. **Curr. Op. Struct. Biol.** 13, 325-333.

Cassano AG, Anderson, VE and Harris ME. (2004). Transition states of phopshodiester bond hydrolysis: Information from heavy atom isotope effects. **Biopolymers**. 73, 110-129.

Cassano AG, Anderson VE and Harris ME. (2004). Analysis of solvent nucleophile isotope effects: Evidence for concerted mechanisms and nucleophilic activation by metal ion coordination in non-enzymatic and ribozyme catalyzed phosphodiester hydrolysis. **Biochemistry.** 43(32):10547-59.

Zahler, NH and Harris ME. (2004). "*Site-Specific Modification of RNA*" *in* Handbook of RNA Biochemistry, Wiley. Hartmann, Binderief, Shon and Westhof, eds.

Harris ME and Christian EL. (2004). "*Probing RNA Structure by Photoaffinity Crosslinking With 4-Thiourine and 6-Thioguanosine*" *in* Handbook of RNA Biochemistry, Wiley. Hartmann, Binderief, Shon and Westhof, eds.

Zahler NH, Sun L, Christian, EL and Harris ME (2005). The pre-tRNA nucleotide base and 2'-hydroxyl at N(-1) contribute to fidelity in tRNA processing by RNase P. **J. Molec. Biol**. 345(5):969-85.

Guo X, Campbell FE, Christian EL, Anderson VE and Harris ME. (2006) RNA-dependent folding and stabilization of C5 protein during assembly of the E. coli RNase P holoenzyme. **J. Molec. Biol.** 360(1):190-203

Christian EL, Johnson K, Perrera N and Harris ME (2006). Evidence for a role for the P4 metal binding site in enhancing catalytic metal ion affinity by substrate positioning. **RNA** 12(8):1463-7.

Sun L, Campbell FE and Harris ME (2006) Substrate specific effects of C5 protein lead to uniformity in binding and catalysis by RNase P. **EMBO J.** 25(17):3998-4007.

Anderson VE, Harris ME and Cassano AG. (2006) "*Nucleophile Isotope Effects*" in Isotope Effects in Chemistry and Biology. CRC Press. Kohen A, Limbach H-H (eds)

Anderson VE, Ruszczysky M and Harris ME (2006). Nucleophilic activation in enzyme catalysis. **Chem. Rev.** *106(8):3236-51.*

Sun L and Harris ME (2007). Binding of C5 protein to the P RNA ribozyme increases catalytic rate by influencing active site metal ion affinity. **RNA** 34:1-11. PMID: 17652407

Cassano AG, Wang B, Anderson DR, Previs S, Harris ME, and Anderson VE. (2007). Inaccuracies in selected ion monitoring determination of isotope ratios obviated by profile acquisition: nucleotide $^{18}O/^{16}O$ measurements. **Anal. Biochem.** 367(1):28-39. PMID: 17560863

Harris ME and Anderson VE. (2007) "*Chemistry of Natural Ribozymes*". Encyclopedia of Chemical Biology. Wiley.

Dai Q, Frederiksen JK, Anderson VE, Harris ME, Piccirilli JA. (2008). Efficient synthesis of [2'-^{18}O]uridine and its incorporation into oligonucleotides: a new tool for mechanistic study of

nucleotidyl transfer reactions by isotope effect analysis. **J Org Chem.** 73(1):309-11. PMID: 18052189

Harris ME and Christian EL. (2008). "*Probing RNA Structure by Photoaffinity Crosslinking with 4-Thiouridine and 6-Thioguanosine"* in Handbook of RNA Biochemistry. pp 374-384. Hartmann RK, Bindereif A, Schön A, and Westhof E, eds. Wiley. ISBN: 9783527308262

Zahler N and Harris ME. (2008). "*Co- and Post-Transcriptional Incorporation of Specific Modifications Including Photoreactive Groups into RNA Molecules"* in Handbook of RNA Biochemistry. pp. 75-85. Hartmann RK, Bindereif A, Schön A, and Westhof E, eds. Wiley. ISBN: 9783527308262

Harris ME, and Cassano AG. (2008). Experimental analyses of the chemical dynamics of ribozyme catalysis. **Curr Opin Chem Biol**. 12(6):626-39. PMID: 18952193

Harris ME. (2009). "*Catalytic Modes of Biological Ribozymes*" Wiley Encyclopedia of Chemical Biology. Begley T. ed. Wiley. ISBN: 978-0-471-75477-0.

Schroeder LA, Gries TJ, Saecker RM, Record MT Jr, Harris ME, and DeHaseth PL. (2009). Evidence for a tyrosine-adenine stacking interaction and for a short-lived open intermediate subsequent to initial binding of Escherichia coli RNA polymerase to promoter DNA. **J Mol Biol.** 385(2):339-49. PMID: 18976666

Christian EL and Harris ME (2009). "*RNA crosslinking methods*" in Biophysical, Chemical, and Functional Probes of RNA Structure, Interactions and Folding: Part A **Methods in Enzymology** Volume 468, pp. 127-146. Herschlag, D. ed. Elsevier. ISBN: 978-0-12-374399-2

Harris ME and Christian EL. (2009). "*Understanding the role of meal ions in RNA folding and function: Lessons from RNase P, a ribonucleoprotein enzyme*" in Springer Series in Biophysics 13: Non-Protein Coding RNAs. pp183-214. Walter NG, Woodson SA and Batey RT, eds. Springer-Verlag Berlin Heidelberg ISBN 0932-2353

Sun L, Campbell FE, Yandek LE, and Harris ME. (2010). Binding of the C5 protein to P RNA enhances the rate constant for catalysis for P RNA processing of pre-tRNAs lacking a consensus G(1)-C(72) base pair. **J Mol Biol.** 395(5):1019-37. PMID: 19917291.

Koutmou KS, Zahler NH, Kurz JC, Campbell FE, Harris ME, Fierke CA. (2010). Protein-precursor tRNA contact leads to sequence-specific recognition of 5' leaders by bacterial ribonuclease P. **J Mol Biol**. 12;396(1):195-208. PMID: 19932118

Christian EL, Anderson VE, Carey PR, Harris ME. (2010). A quantitative Raman spectroscopic signal for metal-phosphodiester interactions in solution. **Biochemistry**. 49(13):2869-79. PMID: 20180599

Harris ME and Yandek LE. (2010). "*Challenges in substrate recognition by RNase P*: *Facing up to the biological context*" in Protein Reviews Volume 10: Ribonuclease P. pp 135-152. Altman S and Lui F, eds. Springer New York. ISBN 978-1-4419-1141-4

Harris ME, Dai Q, Gu H, Kellerman DE, Piccirilli JA, and Anderson VE (2010). Kinetic isotope effects for RNA cleavage by 2'-*O*-transphosphorylation: Nucleophilic activation by specific base. **J. Am. Chem. Soc.** 132(33):11613-21 PMID: 20669950

Christian EL, Anderson VE, Carey PC and Harris ME (2011). Deconvolution of electrostatic, H-bonding, and inner-sphere coordination interactions and dimethyl phosphate in solution by Raman spectroscopy**. J Inorg Biochem**. *In press*