BIOS 21229 Genome Informatics: How Cells Reorganize Genomes

Winter 2010 TuTh 12:00 - 1:20, Wed 3:00– 4:20 (BSLC 305)

Instructor: Professor J. Shapiro (GCIS W123B, jsha@uchicago.edu)

WEEK	DATE	DAY	TIME	TOPIC	Due
1	Jan 5	Tu	12:00	Introduction; How are genomes organized, how did they get that way? - Use of Blackboard, Google, PubMed &, electronic journals; Paper topics	
	Jan 6	Wed	3:00	Extracellular signaling in bacterial DNA transfer: Tomasz A, Hotchkiss RD. Regulation of the transformability of pneumococcal cultures by macromolecular cell products. Proc Natl Acad Sci U S A. 1964 Mar;51:480-7.	
	Jan 7	Th	12:00	Environmental signaling in bacterial DNA uptake: Meibom KL, Blokesch M, Dolganov NA, Wu CY, Schoolnik GK. Chitin induces natural competence in Vibrio cholerae. Science. 2005 Dec 16;310(5755):1824-7.	
2	Jan 12	Tu	12:00	Multiple recombination systems in *E. coli*: Barbour SD, Nagaishi H, Templin A, Clark AJ.Biochemical and genetic studies of recombination proficiency in Escherichia coli. II. Rec+ revertants caused by indirect suppression of rec- mutations. Proc Natl Acad Sci U S A. 1970 Sep;67(1):128-35.	
	Jan 13	Wed	3:00	Barbour et al., 1970.	
	Jan 14	Th	12:00	Role of special sites in homologous recombination: El Karoui, Meriem, Schaeffer, Matthieu, Biaudet, Véronique, Bolotin, Alexandre, Sorokin, Alexeï & Gruss, Alexandra (2000) Orientation specificity of the Lactococcus lactis Chi site. Genes to Cells 5 (6), 453-461.	
3	Jan 19	Tu	12:00	SOS mutagenesis; Mutagenic specifities of different repair polymerases: Napolitano et al. All three SOS-inducible DNA polymerases (Pol II, PolIV and PolV) are involved in induced mutagenesis. EMBO J. 2000 19:6259-65	
	Jan 20	Wed	3:00	Napolitano et al, 2000	
	Jan 21	Th	12:00	Checkpoints in DNA damage response: Weinert TA, Hartwell LH. The RAD9 gene controls the cell cycle response to DNA damage in Saccharomyces cerevisiae. Science. 1988 Jul 15;241(4863):317-22.	Paper 1 outline
4	Jan 26	Tu	12:00	Weinert & Hartwell;	
	Jan 27	Wed	3:00	Site-specific recombination function & mechanism: Bouvier M, Demarre G, Mazel D. Integron cassette insertion: a recombination process involving a folded single strand substrate. EMBO J. 2005 Dec 21;24(24):4356-67	
	Jan 28	Th	12:00	Bouvier et al ; Submit Paper 1 by 11:59 PM	Paper 1
5	Feb 2	Tu	12:00	Jeffrey P Mumm, Arthur Landy and Jeff Gelles. Viewing single site-specific recombination events from	

				start to finish. *The EMBO Journal* (2006) **25,** 4586–4595.	
	Feb 3	Wed	3:00	Mechanisms of DNA transposition: May,E.W. and Craig,N.L. (1996) Switching from cut-and-paste to replicative Tn7 transposition. Science, 272, 401–404	
	Feb 4	Th	12:00	May & Craig	Paper 2 topic
6	Feb 9	Tu	12:00	Making transgenics with a DNA transposon; Hybrid dysgenesis, P factors: Spradling AC, Rubin GM. Transposition of cloned P elements into Drosophila germ line chromosomes. Science. 1982 Oct 22;218(4570):341-7.	
	Feb 10	Wed	3:00	Spradling & Rubin	
	Feb 11	Th	12:00	Retroviruses and retrotransposons; Reverse transcription and insertion of LTR-containing retroelements: Boeke JD, Garfinkel DJ, Styles CA, Fink GR. Ty elements transpose through an RNA intermediate. Cell. 1985 Mar;40(3):491-500.	
7	Feb 16	Tu	12:00	Retroviruses and retrotransposons; targeting insertions in the genome: Xie W, Gai X, Zhu Y, Zappulla DC, Sternglanz R, Voytas DF. Targeting of the yeast Ty5 retrotransposon to silent chromatin is mediated by interactions between integrase and Sir4p. Mol Cell Biol. 2001 Oct;21(19):6606-14.	
	Feb 17	Wed	3:00	Target-primed reverse transcription; Retrotransduction of nearby sequences: Moran JV, DeBerardinis RJ, Kazazian HH Jr. Exon shuffling by L1 retrotransposition. Science. 1999 Mar 5;283(5407):1530-4.	
	Feb 18	Th	12:00	RNAi regulation of transposable elements: Julius Brennecke, Alexei A. Aravin, Alexander Stark, Monica Dus, Manolis Kellis, Ravi Sachidanandam, and Gregory J. Hannon. Discrete Small RNA-Generating Loci as Master Regulators of Transposon Activity in *Drosophila*. Cell, Vol 128, 1089-1103, 23 March 2007	
8	Feb 23	Tu	12:00	Brennecke et al.	
	Feb 24	Wed	3:00	Bacterial RNAi? - Rodolphe Barrangou, Christophe Fremaux, Hélène Deveau, Melissa Richards, Patrick Boyaval, Sylvain Moineau, Dennis A. Romero, Philippe Horvath. CRISPR Provides Acquired Resistance Against Viruses in Prokaryotes. *Science* 23 March 2007:_Vol. 315. no. 5819, pp. 1709 – 1712.	
	Feb 25	Th	12:00	Immune system variability, VDJ joining: Agrawal A, Eastman QM, Schatz DG. Transposition mediated by RAG1 and RAG2 and its implications for the evolution of the immune system. Nature. 1998 Aug 20;394(6695):744-51.	Paper 2 outline
9	Mar 2	Tu	12:00	Immune system variability, class switching & somatic hypermutation: Shinkura R, Ito S, Begum NA, Nagaoka H, Muramatsu M, Kinoshita K, Sakakibara Y, Hijikata H, Honjo T. Separate domains of AID are required for somatic hypermutation and class-switch recombination. Nat Immunol. 2004 Jul;5(7):707-12.	
	Mar 3	Wed	3:00	Shinkura et al.	

	Mar 4	Thu	12:00	Diversity generated with reverse transcriptase in bacteria: Liu M, Deora R, Doulatov SR, Gingery M, Eiserling FA, Preston A, Maskell DJ, Simons RW, Cotter PA, Parkhill J, Miller JF. Reverse transcriptase-mediated tropism switching in Bordetella bacteriophage. Science 2002 Mar 15;295(5562):2091-4.	
10	Mar 9	Tu	12:00	To be determined	
	Mar 10	Wed	3:00	To be determined; Submit Paper 2 by 11:59 PM	Paper 2
	Mar 11	Th	12:00	READING PERIOD	

Chatterji M, Unniraman S, McBride KM, Schatz DG. Role of activation-induced deaminase protein kinase A phosphorylation sites in Ig gene conversion and somatic hypermutation. J Immunol. 2007 Oct 15;179(8):5274-80

Basu U, Chaudhuri J, Alpert C, Dutt S, Ranganath S, Li G, Schrum JP, Manis JP, Alt FW. The AID antibody diversification enzyme is regulated by protein kinase A phosphorylation. Nature. 2005 Nov 24;438(7067):508-11. Epub 2005 Oct 26.

Chaudhuri J, Basu U, Zarrin A, Yan C, Franco S, Perlot T, Vuong B, Wang J, Phan RT, Datta A, Manis J,Alt FW. Evolution of the immunoglobulin heavy chain class switch recombination mechanism. Adv Immunol. 2007;94:157-214.

McBride KM, Gazumyan A, Woo EM, Schwickert TA, Chait BT, Nussenzweig MC. Regulation of class switch recombination and somatic mutation by AID phosphorylation. J Exp Med. 2008 Oct 27;205(11):2585-94. Epub 2008 Oct 6.

Shinkura R, Ito S, Begum NA, Nagaoka H, Muramatsu M, Kinoshita K, Sakakibara Y, Hijikata H, Honjo T. Separate domains of AID are required for somatic hypermutation and class-switch recombination. Nat Immunol. 2004 Jul;5(7):707-12. Epub 2004 Jun 13.

Xu Z, Pone EJ, Al-Qahtani A, Park SR, Zan H, Casali P. Regulation of aicda expression and AID activity: relevance to somatic hypermutation and class switch DNA recombination. Crit Rev Immunol. 2007;27(4):367-97. Review.

Liu M, Deora R, Doulatov SR, Gingery M, Eiserling FA, Preston A, Maskell DJ, Simons RW, Cotter PA, Parkhill J, Miller JF. Reverse transcriptase-mediated tropism switching in Bordetella bacteriophage. Science. 2002 Mar 15;295(5562):2091-4.

Liu M, Gingery M, Doulatov SR, Liu Y, Hodes A, Baker S, Davis P, Simmonds M, Churcher C, Mungall K, Quail MA, Preston A, Harvill ET, Maskell DJ, Eiserling FA, Parkhill J, Miller JF. Genomic and genetic analysis of Bordetella bacteriophages encoding reverse transcriptase-mediated tropism-switching cassettes. J Bacteriol. 2004 Mar;186(5):1503-17.

Medhekar, Bob, Miller, Jeff F. Diversity-generating retroelements. CURRENT OPINION IN MICROBIOLOGY 10 (4): 388-395 AUG 2007

Val ME, Bouvier M, Campos J, Sherratt D, Cornet F, Mazel D, Barre FX. The single-stranded genome of phage CTX is the form used for integration into the genome of Vibrio cholerae. Mol Cell. 2005 Aug 19;19(4):559-66.

Capiaux H, Lesterlin C, Perals K, Louarn JM, Cornet F. A dual role for the FtsK protein in Escherichia coli chromosome segregation. EMBO Rep. 2002 Jun;3(6):532-6.

Reijns M, Lu Y, Leach S, Colloms SD. Mutagenesis of PepA suggests a new model for the Xer/cer synaptic complex. Mol Microbiol. 2005 Aug;57(4):927-41.

Shapiro JA. Molecular model for the transposition and replication of bacteriophage Mu and other transposable elements. Proc Natl Acad Sci U S A. 1979 Apr;76(4):1933-7.

Michelson RJ, Rosenstein S, Weinert T. A telomeric repeat sequence adjacent to a DNA double-stranded break produces an anticheckpoint. Genes Dev. 2005 Nov 1;19(21):2546-59.

Helitrons and protein/genome evolution

Galit Lev-Maor, Rotem Sorek, Erez Y Levanon, Nurit Paz, Eli Eisenberg and Gil Ast. RNA-editing-mediated exon evolution *Genome Biology* 2007, 8:R29

General Web sites that can be used as textbooks for the course:

The NCBI Bookshelf (http://www.ncbi.nlm.nih.gov/entrez/query.fcgi?db=Books) makes available the textbooks *Introduction to Genetic Analysis* and *Modern Genetic Analysis*, as well as *Molecular Biology of the Cell* and *Molecular Cell Biology*.

Stan Maloy, Microbial Genetics (www.sci.sdsu.edu/~smaloy/MicrobialGenetics/topics/topics-detail.html)

Martin E. Mulligan, Prokaryotic Gene Regulation and Genetics (http://www.mun.ca/biochem/courses/4103/lectures.html)

Dictionaries and Glossaries:

The Hypermedia Glossary of Genetic Terms (http://www.weihenstephan.de/%7Eschlind/genglos.html) is maintained by B. Schlindwein, Weihenstephan Library of the Technische Universit"t M¸nchen, Germany.

A dictionary of genetic terms (http://www.ornl.gov/hgmis/publicat/primer2001/glossary.html) is provided by the Human Genome Project Information Web site

A genetics glossary (http://helios.bto.ed.ac.uk/bto/glossary/index.html) is made available by the Biology Teaching Organisation (BTO) of the University of Edinburgh.