

Final Progress Report for Research Projects Funded by Health Research Grants

Instructions: Please complete all of the items as instructed. Do not delete instructions. Do not leave any items blank; responses must be provided for all items. If your response to an item is “None”, please specify “None” as your response. “Not applicable” is not an acceptable response for any of the items. There is no limit to the length of your response to any question. Responses should be single-spaced, no smaller than 12-point type. The report **must be completed using MS Word**. Submitted reports must be Word documents; they should not be converted to pdf format. Questions? Contact Health Research Program staff at 717-231-2825.

1. **Grantee Institution:** Trustees of the University of Pennsylvania
2. **Reporting Period (start and end date of grant award period):** 1/1/2011 – 12/31/2014
3. **Grant Contact Person (First Name, M.I., Last Name, Degrees):** Gearline Robinson-Hall, BSF
4. **Grant Contact Person’s Telephone Number:** 215-746-6821
5. **Grant SAP Number:** 4100054874
6. **Project Number and Title of Research Project:** 1- Research Infrastructure: Renovation for Laboratory Space for Biological Chemistry
7. **Start and End Date of Research Project:** 1/1/2011 – 6/30/2012
8. **Name of Principal Investigator for the Research Project:** Richard M. Schultz, PhD
9. **Research Project Expenses.**

9(A) Please provide the total amount of health research grant funds spent on this project for the entire duration of the grant, including indirect costs and any interest earned that was spent:

\$ 981,053

9(B) Provide the last names (include first initial if multiple individuals with the same last name are listed) of **all** persons who worked on this research project and were supported with health research funds. Include position titles (Principal Investigator, Graduate Assistant, Post-doctoral Fellow, etc.), percent of effort on project and total health research funds expended for the position. For multiple year projects, if percent of effort varied from year to year, report in the % of Effort column the effort by year 1, 2, 3, etc. of the project (x% Yr 1; z% Yr 2-3).

Last Name, First Name	Position Title	% of Effort on Project	Cost
None			

9(C) Provide the names of **all** persons who worked on this research project, but who *were not* supported with health research funds. Include position titles (Research Assistant, Administrative Assistant, etc.) and percent of effort on project. For multiple year projects, if percent of effort varied from year to year, report in the % of Effort column the effort by year 1, 2, 3, etc. of the project (x% Yr 1; z% Yr 2-3).

Last Name, First Name	Position Title	% of Effort on Project
Schultz, Richard	Principal Investigator	1%

9(D) Provide a list of **all** scientific equipment purchased as part of this research grant, a short description of the value (benefit) derived by the institution from this equipment, and the cost of the equipment.

Type of Scientific Equipment	Value Derived	Cost
None		

10. Co-funding of Research Project during Health Research Grant Award Period. Did this research project receive funding from any other source during the project period when it was supported by the health research grant?

Yes No

If yes, please indicate the source and amount of other funds:

University of Pennsylvania - \$180,000

11. Leveraging of Additional Funds

11(A) As a result of the health research funds provided for this research project, were you able to apply for and/or obtain funding from other sources to continue or expand the research?

Yes No

If yes, please list the applications submitted (column A), the funding agency (National Institutes of Health—NIH, or other source in column B), the month and year when the application was submitted (column C), and the amount of funds requested (column D). If you have received a notice that the grant will be funded, please indicate the amount of funds to be awarded (column E). If the grant was not funded, insert “not funded” in column E.

Do not include funding from your own institution or from CURE (tobacco settlement funds). Do not include grants submitted prior to the start date of the grant as shown in Question 2. If you list grants submitted within 1-6 months of the start date of this grant, add a statement below the table indicating how the data/results from this project were used to secure that grant.

A. Title of research project on grant application	B. Funding agency (check those that apply)	C. Month and Year Submitted	D. Amount of funds requested:	E. Amount of funds awarded:
None	<input type="checkbox"/> NIH <input type="checkbox"/> Other federal (specify: _____) <input type="checkbox"/> Nonfederal source (specify: _)		\$	\$

11(B) Are you planning to apply for additional funding in the future to continue or expand the research?

Yes _____ No X _____

If yes, please describe your plans:

12. Future of Research Project. What are the future plans for this research project?

This project was a major infrastructure renovation which transformed old and deteriorated wet chemistry lab space on the 3rd floor of the Chemistry CRET building into a state-of-the-art Biochemistry research laboratory, office and meeting space for Dr. Ivan Dmochowski who has made seminal contributions in the areas of gene regulation, materials chemistry and mechanistic studies of anesthesia.

13. New Investigator Training and Development. Did students participate in project supported internships or graduate or post-graduate training for at least one semester or one summer?

Yes _____ No X _____

If yes, how many students? Please specify in the tables below:

	Undergraduate	Masters	Pre-doc	Post-doc
Male				
Female				
Unknown				
Total				

	Undergraduate	Masters	Pre-doc	Post-doc
Hispanic				
Non-Hispanic				
Unknown				
Total				

	Undergraduate	Masters	Pre-doc	Post-doc
White				
Black				
Asian				
Other				
Unknown				
Total				

14. Recruitment of Out-of-State Researchers. Did you bring researchers into Pennsylvania to carry out this research project?

Yes _____ No X _____

If yes, please list the name and degree of each researcher and his/her previous affiliation:

15. Impact on Research Capacity and Quality. Did the health research project enhance the quality and/or capacity of research at your institution?

Yes X _____ No _____

If yes, describe how improvements in infrastructure, the addition of new investigators, and other resources have led to more and better research.

Before this renovation took place, research was being conducted in undersized spaces that lacked adequate HVAC systems, temperature controls, modern and safe fume hoods and casework. With modernized systems, dramatically improved quality of space, improved airflow, space for light sensitive microscopy, and improved electrical power delivery, the laboratory has been able to operate all of its associated equipment, recruit a new generation of graduate students and continue to make critical contributions to the body of knowledge in this research area.

16. Collaboration, business and community involvement.

16(A) Did the health research funds lead to collaboration with research partners outside of your institution (e.g., entire university, entire hospital system)?

Yes _____ No X _____

If yes, please describe the collaborations:

16(B) Did the research project result in commercial development of any research products?

Yes _____ No X _____

If yes, please describe commercial development activities that resulted from the research project:

16(C) Did the research lead to new involvement with the community?

Yes _____ No X _____

If yes, please describe involvement with community groups that resulted from the research project:

17. Progress in Achieving Research Goals, Objectives and Aims.

List the project goals, objectives and specific aims (as contained in the grant agreement). Summarize the progress made in achieving these goals, objectives and aims for the period that the project was funded (i.e., from project start date through end date). Indicate whether or not each goal/objective/aim was achieved; if something was not achieved, note the reasons why. Describe the methods used. If changes were made to the research goals/objectives/aims, methods, design or timeline since the original grant application was submitted, please describe the changes. Provide detailed results of the project. Include evidence of the data that was generated and analyzed, and provide tables, graphs, and figures of the data. List published abstracts, poster presentations and scientific meeting presentations at the end of the summary of progress; peer-reviewed publications should be listed under item 20.

This response should be a DETAILED report of the methods and findings. It is not sufficient to state that the work was completed. Insufficient information may result in an unfavorable performance review, which may jeopardize future funding. If research findings are pending publication you must still include enough detail for the expert peer reviewers to evaluate the progress during the course of the project.

Health research grants funded under the Tobacco Settlement Act will be evaluated via a performance review by an expert panel of researchers and clinicians who will assess project work using this Final Progress Report, all project Annual Reports and the project's strategic plan. After the final performance review of each project is complete, approximately 12-16 months after the end of the grant, this Final Progress Report, as well as the Final Performance Review Report containing the comments of the expert review panel, and the grantee's written response to the Final Performance Review Report, will be posted on the CURE Web site.

There is no limit to the length of your response. Responses must be single-spaced below, no smaller than 12-point type. If you cut and paste text from a publication, be sure symbols print properly, e.g., the Greek symbol for alpha (α) and beta (β) should not print as boxes (\square) and include the appropriate citation(s). DO NOT DELETE THESE INSTRUCTIONS.

A total of 3950 square feet (Rooms 330, 330A, 331, 332, 333, 333A 334) is now dedicated to the work of Associate Professor Ivan J. Dmochowski and consists of spaces devoted to synthetic chemistry preparations, biological chemistry, student meeting rooms, light sensitive microscopy and radioactive materials preparation.

Work included updates to the HVAC systems and diffusers to improve airflow in the laboratory, new wall finishes and floor surfaces, replacement of casework, laboratory benches and shelving, replacement of fume hoods, and upgrades to the electricity in the rooms to improve power sources for the equipment to be installed. Since this project (and with separate funding), the School has also upgraded the exhaust and supply systems to reduce the energy usage of this space and further improve the quality of the research space available to our Biochemistry researchers.

A total of 236 square feet (Room 336) was also dedicated to the creation of the Biochemistry Shared Instrumentation Core Facility. Work in this room included replacement of air diffusers to improve airflow in the laboratory, installation of new or refurbished casework, installation of new benches and shelving and refurbished lighting. The facility includes the following equipment: isothermal titration calorimeter, UV-visible spectrometer, fluorometer, peptide synthesizer, DNA synthesizer, liquid chromatography-mass spectrometer, fast protein liquid chromatographer and circular dichroism spectrometer. Much of this equipment was dispersed throughout the Department. This grant did not fund the purchase of any equipment.

Virtually all of the most important challenges facing humanity today require a fundamental understanding of chemistry. Among many others, these challenges include: 1) climate change, both in the short term and in the search for permanent solutions; 2) sustaining our future in terms of energy, food, and other essentials; 3) personal safety, national security, and both personal and public health. Through research efforts that span the traditional sub-disciplines of biological chemistry, inorganic chemistry, organic chemistry, and physical chemistry, chemists perform research that makes a huge positive impact on countless obstinate problems of great importance. At the University of Pennsylvania, there is a long and distinguished history of cutting edge research in all of these diverse areas. In fact, seven Nobel Prize winners have been associated with our Department, and their affiliations have spanned every facet of our educational and research mission: former undergraduates, graduate students, postdoctoral research associates, and faculty.

With increasing frequency, chemists are breaking outside of their traditional boundaries, and they are exploring questions in a cross-disciplinary and multidisciplinary manner. A major motivation for this is the ability to solve problems that interface between disciplines, forging

alliances and providing solutions from perspectives not possible by working in isolation. These types of programs pay huge dividends, and have already resulted in several significant breakthroughs unimaginable just a few short years ago.

An excellent example is the research being performed by one of our outstanding young faculty members, Professor Ivan Dmochowski. Professor Dmochowski has made important contributions to chemistry and biochemistry in the following areas:

First, his laboratory has developed a new paradigm for regulating genes with specially constructed, light-sensitive nucleic acids. Upon ultraviolet laser activation, these molecules bind to messenger RNA (mRNA) and block protein synthesis. In this way, the expression of specific genes can be down-regulated with much higher spatial and temporal resolution than has been possible previously, a process that is very useful in assigning gene function. This greater level of gene regulation is valuable in the study of normal processes (e.g., the process by which embryonic cells divide, migrate, and become specified) as well as gene mis-regulations found in cancer.

Second, Dr. Dmochowski has been a pioneer in the development of magnetic resonance imaging (MRI) contrast agents that employ xenon. This noble gas element has unique physical properties that provide new opportunities for biomedical imaging applications. Dr. Dmochowski has shown that the isotope Xe-129 has tremendous potential to increase the molecular information that can be obtained from diseased tissues (e.g., a tumor) in a standard MRI procedure. Dr. Dmochowski has demonstrated one particularly attractive feature of xenon MRI contrast agents: protein biomarkers that represent healthy and diseased tissue can be identified and readily distinguished using Xe-129 MRI biosensors. Using xenon technology, it should be possible some day to detect and treat cancer in human patients much earlier than has been possible previously. Dr. Dmochowski is a leading expert in the design of synthetic carbon-based materials that bind xenon with very high affinity and deliver xenon to specific receptors on cell surfaces. The Dmochowski laboratory has shown that these compounds can be delivered to cancer cells and imaged using Xe-129 MRI.

Third, Dr. Dmochowski's laboratory has pioneered research involving the mechanistic studies of anesthesia. Remarkably, human patients have been anesthetized during surgery for the past 160 years, and yet we still do not know how anesthetics work at the molecular level, or even the targets of anesthetics in the human body. This lack of molecular detail has made it very difficult to develop more potent anesthetic molecules with reduced toxicity and morbidity. Dr. Dmochowski led an effort that recently identified the first anesthetic molecule that is intrinsically fluorescent and can be imaged by fluorescence microscopy. Dr. Dmochowski has produced the first high-resolution images of functioning anesthetic molecules inside living, immobilized animals (to date, zebrafish, tadpoles, and nematodes). Remarkably, specific neurons were identified in the brains of these animals that selectively uptake the fluorescent anesthetic. This was a watershed event in the field of anesthesia, and the first publication on this work appeared in *Proc. Natl. Acad. Sci. U.S.A.* in April, 2009 and received widespread press, including an article in *Science Daily*. It is relevant that all plants, prokaryotes and eukaryotes are susceptible to anesthetics, and at roughly the same dose of anesthetic. This suggests that there is a very common and abundant target to which all anesthetics are binding and producing an effect, which in humans we associate with a loss of

consciousness and sensory perception. Research has progressed very rapidly in the Dmochowski laboratory to identify and validate a protein target that is abundant in mitochondria and is responsible for producing anesthetic effects. This is a crowning achievement in biological chemistry and one that will make Dr. Dmochowski increasingly visible in the biomedical community as this work is further developed and disseminated over the next few years.

The ability of this cutting-edge research group to reach its full potential was limited by the poor quality and lack of continuity of the research space that they occupied in the Chemistry 1973 and Chemistry 1941 buildings. The infrastructure that was renewed under this project has enabled the research described above to continue at the University of Pennsylvania to pursue the scientific goals outlined.

18. Extent of Clinical Activities Initiated and Completed. Items 18(A) and 18(B) should be completed for all research projects. If the project was restricted to secondary analysis of clinical data or data analysis of clinical research, then responses to 18(A) and 18(B) should be “No.”

18(A) Did you initiate a study that involved the testing of treatment, prevention or diagnostic procedures on human subjects?

Yes
 No

18(B) Did you complete a study that involved the testing of treatment, prevention or diagnostic procedures on human subjects?

Yes
 No

If “Yes” to either 18(A) or 18(B), items 18(C) – (F) must also be completed. (Do NOT complete 18(C-F) if 18(A) and 18(B) are both “No.”)

18(C) How many hospital and health care professionals were involved in the research project?

_____ Number of hospital and health care professionals involved in the research project

18(D) How many subjects were included in the study compared to targeted goals?

_____ Number of subjects originally targeted to be included in the study
_____ Number of subjects enrolled in the study

Note: Studies that fall dramatically short on recruitment are encouraged to provide the details of their recruitment efforts in Item 17, Progress in Achieving Research Goals, Objectives and Aims. For example, the number of eligible

subjects approached, the number that refused to participate and the reasons for refusal. Without this information it is difficult to discern whether eligibility criteria were too restrictive or the study simply did not appeal to subjects.

18(E) How many subjects were enrolled in the study by gender, ethnicity and race?

Gender:

Males
 Females
 Unknown

Ethnicity:

Latinos or Hispanics
 Not Latinos or Hispanics
 Unknown

Race:

American Indian or Alaska Native
 Asian
 Blacks or African American
 Native Hawaiian or Other Pacific Islander
 White
 Other, specify: _____
 Unknown

18(F) Where was the research study conducted? (List the county where the research study was conducted. If the treatment, prevention and diagnostic tests were offered in more than one county, list all of the counties where the research study was conducted.)

19. Human Embryonic Stem Cell Research. Item 19(A) should be completed for all research projects. If the research project involved human embryonic stem cells, items 19(B) and 19(C) must also be completed.

19(A) Did this project involve, in any capacity, human embryonic stem cells?

Yes
 No

19(B) Were these stem cell lines NIH-approved lines that were derived outside of Pennsylvania?

Yes
 No

19(C) Please describe how this project involved human embryonic stem cells:

20. Articles Submitted to Peer-Reviewed Publications.

20(A) Identify all publications that resulted from the research performed during the funding period and that have been submitted to peer-reviewed publications. Do not list journal abstracts or presentations at professional meetings; abstract and meeting presentations should be listed at the end of item 17. **Include only those publications that acknowledge the Pennsylvania Department of Health as a funding source** (as required in the grant agreement). List the title of the journal article, the authors, the name of the peer-reviewed publication, the month and year when it was submitted, and the status of publication (submitted for publication, accepted for publication or published.). Submit an electronic copy of each publication or paper submitted for publication, listed in the table, in a PDF version 5.0.5 (or greater) format, 1,200 dpi. Filenames for each publication should include the number of the research project, the last name of the PI, and an abbreviated title of the publication. For example, if you submit two publications for Smith (PI for Project 01), one publication for Zhang (PI for Project 03), and one publication for Bates (PI for Project 04), the filenames would be:

- Project 01 – Smith – Three cases of isolated
- Project 01 – Smith – Investigation of NEB1 deletions
- Project 03 – Zhang – Molecular profiling of aromatase
- Project 04 – Bates – Neonatal intensive care

If the publication is not available electronically, provide 5 paper copies of the publication.

Note: The grant agreement requires that recipients acknowledge the Pennsylvania Department of Health funding in all publications. Please ensure that all publications listed acknowledge the Department of Health funding. If a publication does not acknowledge the funding from the Commonwealth, do not list the publication.

Title of Journal Article:	Authors:	Name of Peer-reviewed Publication:	Month and Year Submitted:	Publication Status (check appropriate box below):
1. None				<input type="checkbox"/> Submitted <input type="checkbox"/> Accepted <input type="checkbox"/> Published

20(B) Based on this project, are you planning to submit articles to peer-reviewed publications in the future?

Yes _____ No X

If yes, please describe your plans:

21. Changes in Outcome, Impact and Effectiveness Attributable to the Research Project.

Describe the outcome, impact, and effectiveness of the research project by summarizing its impact on the incidence of disease, death from disease, stage of disease at time of diagnosis,

or other relevant measures of outcome, impact or effectiveness of the research project. If there were no changes, insert “None”; do not use “Not applicable.” Responses must be single-spaced below, and no smaller than 12-point type. DO NOT DELETE THESE INSTRUCTIONS. There is no limit to the length of your response.

This project was a lab space infrastructure improvement project and its effects on the incidence of disease, death from disease, stage of disease at time of diagnosis, or other relevant measures of outcome, impact or effectiveness will be long-term and difficult to quantify.

22. Major Discoveries, New Drugs, and New Approaches for Prevention Diagnosis and Treatment. Describe major discoveries, new drugs, and new approaches for prevention, diagnosis and treatment that are attributable to the completed research project. If there were no major discoveries, drugs or approaches, insert “None”; do not use “Not applicable.” Responses must be single-spaced below, and no smaller than 12-point type. DO NOT DELETE THESE INSTRUCTIONS. There is no limit to the length of your response.

None

23. Inventions, Patents and Commercial Development Opportunities.

23(A) Were any inventions, which may be patentable or otherwise protectable under Title 35 of the United States Code, conceived or first actually reduced to practice in the performance of work under this health research grant? Yes _____ No X

If “Yes” to 23(A), complete items a – g below for each invention. (Do NOT complete items a - g if 23(A) is “No.”)

- a. Title of Invention:
- b. Name of Inventor(s):
- c. Technical Description of Invention (describe nature, purpose, operation and physical, chemical, biological or electrical characteristics of the invention):
- d. Was a patent filed for the invention conceived or first actually reduced to practice in the performance of work under this health research grant?
Yes _____ No _____

If yes, indicate date patent was filed:

- e. Was a patent issued for the invention conceived or first actually reduced to practice in the performance of work under this health research grant?
Yes _____ No _____

If yes, indicate number of patent, title and date issued:

Patent number:

Title of patent:

Date issued:

- f. Were any licenses granted for the patent obtained as a result of work performed under this health research grant? Yes _____ No _____

If yes, how many licenses were granted? _____

- g. Were any commercial development activities taken to develop the invention into a commercial product or service for manufacture or sale? Yes ___ No ___

If yes, describe the commercial development activities:

23(B) Based on the results of this project, are you planning to file for any licenses or patents, or undertake any commercial development opportunities in the future?

Yes _____ No X _____

If yes, please describe your plans:

24. Key Investigator Qualifications. Briefly describe the education, research interests and experience and professional commitments of the Principal Investigator and all other key investigators. In place of narrative you may insert the NIH biosketch form here; however, please limit each biosketch to 1-2 pages.

BIOGRAPHICAL SKETCH

Provide the following information for the Senior/key personnel and other significant contributors in the order listed on Form Page 2.
Follow this format for each person. **DO NOT EXCEED FOUR PAGES.**

NAME Richard M. Schultz	Professor		
eRA COMMONS USER NAME (credential, e.g., agency login) RSCHULTZ			
<i>EDUCATION/TRAINING (Begin with baccalaureate or other initial professional education, such as nursing, include postdoctoral training and residency training if applicable.)</i>			
INSTITUTION AND LOCATION	DEGREE <i>(if applicable)</i>	MM/YY	FIELD OF STUDY
Brandeis University, Waltham, MA	B.A.	1971	Biology
Harvard University, Cambridge, MA	Ph.D.	1975	Biochemistry
Harvard Medical School, Boston, MA	Post-doc	1978	Dev. Biol.

B. Positions and Honors

Positions and Employment

1978-1984	Assistant Professor of Biology, University of Pennsylvania
1984-1990	Associate Professor of Biology, University of Pennsylvania
1990-pres	Professor of Biology, University of Pennsylvania
2001-2007	Patricia Williams Term Chair, University of Pennsylvania
2004-2008	Department Chair
2007-pres	Charles and William L. Day Distinguished Professor of Biology
2008-pres	Associate Dean for the Natural Sciences

Other Experience and Professional Memberships

Society for the Study of Reproduction
AAAS

Honors

1987-1991,	Member of Dev Bio Panel, NSF
1992	Chairman, Gordon Conference on Mammalian Gametogenesis and Embryogenesis
1990-1995,	Chairman, Biology Graduate Group, U.Penn
1993-1995	Member, Reproductive Biology Study Section, NIH
1994	Recipient of Jan Purkinje Medal from The Czech Republic Academy of Science
1995-1996,	Member University Committee on Appointments and Promotions
1996	Elected Fellow of AAAS
1997-2007	NIH MERIT Award (HD22861)
1998-2001	Member, Reproductive Biology Study Section, NIH (completed term starting in 1993)
1999	Chair, Program Committee for 1999 Society for the Study of Reproduction (SSR) meeting
2001-2004	Director, SSR.
2003	Visiting Scholar, The Jackson Lab
2005	Recipient of Society of Reproduction and Fertility Distinguished Scientist Award
2006-pres	Member, Scientific Advisory Board, Max Planck Institute for Molecular Biomedicine in Münster
2009	Recipient of the Society for the Study of Reproduction Research Award
2012	Elected VP-Elect for Society for the Study of Reproduction; will serve as President 2014/2015

Editorial Boards

1987-2004, Associate Editor, Molecular Reproduction & Development
1993-2004, Editor, BioEssays
1995-2004, Editorial Board, Biology of Reproduction
2000-2005, Editorial Board, Developmental Biology
2004-2009, Associate Editor, Biology of Reproduction
2009-2013, Editorial Board, Biology of Reproduction

C. Selected Peer-reviewed Publications (Selected from 285)

- Medvedev, S., Pan H., and Schultz, R.M. (2011). Absence of MSY2 in mouse oocytes perturbs oocyte growth and maturation, RNA stability, and the transcriptome. *Biol. Reprod.* 85, 575-583. PMID: 21613634
- Ma, P., Pan, H., Montgomery, R.L., Olson, E.N., and Schultz, R.M. (2012). Compensatory functions of HDAC1 and HDAC2 regulate transcription and apoptosis during mouse oocyte development. *Proc. Natl. Acad. Sci. USA.* 109, E481-489. PMID: 22223663
- Ma, J., Flemr, M., Strnad, H., Svoboda, P., and Schultz, R.M. (2012). Maternally-recruited DCP1A and DCP2 1 contribute to mRNA degradation during oocyte maturation and genome activation in mouse. *Biol. Reprod.* 88, 1-12. PMID: 23136299
- Ma, P. and Schultz, R.M. (2013). Histone deacetylase 2 (HDAC2) regulates chromosome segregation and kinetochore function via H4K16 deacetylation during oocyte maturation in mouse. *PLoS Gen.* e1003377. PMID: 23516383
- Davydenko, O, Schultz, R.M., and Lampson, M.A. (2013). Increased CDK1 activity determines the timing of kinetochore-microtubule attachments in meiosis I. *J. Cell Biol.* 202, 221-229. PMID: 23857768
- Balboula, A.Z., Stein, P., Schultz, R.M., and Schindler, K. (2013). Knockdown of RBBP7 unveils a requirement for histone deacetylation for CPC function in mouse oocytes. *Cell Cycle.* In Press. PMID: 24317350
- DeWaal, E., Mak, W., Calhoun, S., Stein, P. Ord, T., Krapp, C., Coutifaris, C., Schultz, R.M., and Bartolomei, M.S. (2013). In vitro culture increases the frequency of stochastic epigenetic errors at imprinted genes in placental tissues from mouse concepti produced through assisted reproductive technologies. *Biol. Reprod.* In Press. PMID: 24337315