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Education

1996-1998 M.Sc. (Physics)
1990-1996 B.Sc. (Hon) (Physics-Math)
B.Sc (Biochemistry)

Employment

2004– Staff Scientist
Canada’s Michael Smith Genome Sciences Center

2002–2004 Bioinformatics Leader
Canada’s Michael Smith Genome Sciences Center

1999–2002 System Administrator
Canada’s Michael Smith Genome Sciences Center

Research experience

genome and data visualization; physical map analysis; numerical simulation and modelling; network application development; bioinformatics infrastructure design and management

Impact

	all	since 2012
citations	12,456	7,428
<i>h</i> -index	32	26
<i>i10</i> -index	54	45

updated 7 Jul 2017

Publications—Refereed papers

Albuquerque, M.A., Grande, B.M., Ritch, E.J., Pararajalingam, P., Jessa, S., **Krzywinski, M.**, Grewal, J.K., Shah, S.P., Boutros, P.C. and Morin, R.D., 2017. Enhancing knowledge discovery from cancer genomics data with Galaxy. *Giga Science*, 6(5), pp. 1–13.

Krzywinski, M. & Hirst, M. (2016) SnapShot: Epigenomic Assays. *Cell* **167**:1430.e1.

Lever, J., Gakkhar, S., Gottlieb, M., Rashnavadi, T., Lin, S., Siu, C., Smith, M., Jones, M., **Krzywinski, M.**, Jones, S. A collaborative filtering based approach to biomedical knowledge discovery. (submitted).

Xylinas, E., Hassler, M.R., Zhuang, D., **Krzywinski, M.** *et al.* (2016) An epigenomic approach to improving response to neoadjuvant cisplatin chemotherapy in bladder cancer. *Biomolecules* **6**:37.

Krzywinski, M. (2016) Visualizing Clonal Evolution in Cancer. *Molecular Cell* **62**:652–656.

Krzywinski, M., Nip, K.M., Birol, I. & Marra, M. (2016) Differential Hive Plots—Seeing Networks Change. Leonardo Special Section: Arts, Humanities and Complex Networks 2015. doi:10.1162/LEON_a_01278

Perez, S., Hahn, A., **Krzywinski, M.** & Hallam, S. Hive Panel Explorer: an interactive visualization tool to explore topological and data association patterns in large networks. (In preparation).

Nip, K.M., **Krzywinski, M.** & Birol, I. jhive: an interactive software to visualize and compare network graphs with hive plots. (In preparation).

Hoskins, R.A., Carlson, J.W., Wan, K.H., Park, S., Mendez, I., Galle, S.E., Booth, B.W., Pfeiffer, B.D., George, R.A., Svirskas, R., **Krzywinski, M.** *et al.* (2015) The release 6 reference sequence of the *Drosophila melanogaster* genome. *Genome Research* **25**:445-458.

Lim EL, Trinh DL, Scott DW, Chu A, **Krzywinski M.** *et al.* (2015) Comprehensive miRNA sequence analysis reveals survival differences in diffuse large B-cell lymphoma patients. *Genome Biology* **16**:18.

Ray, W.C., Rumpf, R.W., Sullivan, B., Callahan, N., Magliery, T., Machiraju, R., Wong, B., **Krzywinski, M.** & Bartlett, C.W. Understanding the sequence requirements of protein families: insights from the BioVis 2013 contests. (2014) *BMC Proceedings of the 3rd Annual Symposium on Biological Data Visualization* **8**:Supplement 2:S1 doi: 10.1186/1753-6561-8-S2-S1

de Martino, M., Zhuang, D., Klatte, T., Rieken, M., Rouprêt, M., Xylinas, E., Clozel, T., **Krzywinski, M.** *et al.* (2014) Impact of ERBB2 mutations on in vitro sensitivity of bladder cancer to lapatinib. *Cancer Biology & Therapy* **15**:1239-47.

Pugh TJ, Morozova O, Attiyeh EF, Asgharzadeh S, Wei JS, Auclair D, Carter SL, Cibulskis K, Hanna M, Kiezun A, Kim J, Lawrence MS, Lichtenstein L, McKenna A, Peadarallu CS, Ramos AH, Shefler E, Sivachenko A, Sougnez C, Stewart C, Ally A, Birol I, Chiu R, Corbett RD, Hirst M, Jackman SD, Kamoh B, Khodabakshi AH, **Krzywinski M.** *et al.* (2013) The genetic landscape of high-risk neuroblastoma. *Nature Genet* **45**:279-284.

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Zhang X, Robertson G, **Krzywinski M.** *et al.* Pics: Probabilistic inference for chip-seq. *Biometrics* 2011, **67**:151-163.

Morin RD, Mendez-Lago M, Mungall AJ, Goya R, Mungall KL, Corbett RD, Johnson NA, Severson TM, Chiu R, Field M, Jackman S, **Krzywinski M.** *et al.* Frequent mutation of histone-modifying genes in non-hodgkin lymphoma. *Nature* 2011 **476**:298-303.

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- Castellarin M, Warren RL, Freeman JD, Dreolini L, **Krzywinski M, et al.** *Fusobacterium nucleatum* infection is prevalent in human colorectal carcinoma. *Genome Research* 2011 doi:10.1101/gr.126516.111
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- Pugh TJ, Keyes M, Barclay L, Delaney A, **Krzywinski M, et al.** Sequence variant discovery in DNA repair genes from radiosensitive and radiotolerant prostate brachytherapy patients. *Clinical Cancer Research* 2009 15:5008-16.
- Krzywinski M et al.** Circos: an Information Aesthetic for Comparative Genomics. *Genome Research* 2009 19:1639-1645.
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Publications—Columns

- Krzywinski, M.** & Altman, N. (2017) Points of significance: Classification and decision trees. *Nature Methods* **14** (in print).
- Lever, J., **Krzywinski, M.** & Altman, N. (2017) Points of significance: Principal component analysis. *Nature Methods* **14**:641–642.
- Altman, N. & **Krzywinski, M.** (2017) Points of significance: Clustering. *Nature Methods* **14**:545–546.
- Altman, N. & **Krzywinski, M.** (2017) Points of Significance: Tabular data. *Nature Methods* **14**:329–330.
- Altman, N. & **Krzywinski, M.** (2017) Points of Significance: Interpreting *P* values. *Nature Methods* **14**:213–214.
- Altman, N. & **Krzywinski, M.** (2017) Points of significance: *P* values and the search for significance. *Nature Methods* **14**:3–4.
- Lever, J., **Krzywinski, M.** & Altman, N. (2016) Points of significance: Regularization. *Nature Methods* **13**:803–804.
- Lever, J., **Krzywinski, M.** & Altman, N. (2016) Points of significance: Model selection and overfitting. *Nature Methods* **13**:703–704.
- Krzywinski, M.** (2016) Points of View: Intuitive design. *Nature Methods* **13**:895.
- Krzywinski M.** (2016) Points of View: Binning high-resolution data *Nature Methods* **13**:463.
- Lever, J., **Krzywinski, M.** & Altman, N. (2016) Points of significance: Classifier Evaluation. *Nature Methods* **13**:603–604.
- Lever, J., **Krzywinski, M.** & Altman, N. (2016) Points of significance: Logistic regression. *Nature Methods* **13**:541–542.
- Altman, N. & **Krzywinski, M.** (2016) Points of significance: Regression diagnostics. *Nature Methods* **13**:385–386.
- Altman, N. & Krzywinski, M. (2016) Points of significance: Analyzing outliers: Influential or nuisance. *Nature Methods* **13**:281–282.
- Hunnicut, B.J. & **Krzywinski, M.** (2016) Points of View: Neural circuit diagrams *Nature Methods* **13**:189.
- Hunnicut, B.J. & **Krzywinski, M.** (2016) Points of View: Pathways *Nature Methods* **13**:5.
- Krzywinski, M.** & Altman, N. (2015) Points of significance: Multiple linear regression. *Nature Methods* **12**:1103–1104.
- Altman, N. & **Krzywinski, M.** (2015) Points of significance: Simple linear regression. *Nature Methods* **12**:999–1000.
- Altman, N. & **Krzywinski, M.** (2015) Points of significance: Association, correlation and causation. *Nature Methods* **12**:899–900.
- Puga, J.L, **Krzywinski, M.** & Altman, N. (2015) Points of significance: Bayesian networks. *Nature Methods* **12**:799–800.
- McInerny, G. & **Krzywinski, M.** (2015) Points of View: Untangling Complex Plots. *Nature Methods* **12**:591.
- Kulesa, A., **Krzywinski, M.**, Blainey, P. & Altman, N (2015) Points of Significance: Sampling distributions and the bootstrap. *Nature Methods* **12**:477–478.

- Puga, J.L, **Krzywinski, M.** & Altman, N. (2015) Points of Significance: Bayesian Statistics *Nature Methods* **12**:277–278.
- Puga, J.L, **Krzywinski, M.** & Altman, N. (2015) Points of Significance: Bayes' Theorem *Nature Methods* **12**:277–278.
- Altman, N. & **Krzywinski, M.** (2015) Points of Significance: Split Plot Design. *Nature Methods* **12**:165–166.
- Altman, N. & **Krzywinski, M.** (2015) Points of Significance: Sources of Variation. *Nature Methods* **12**:5–6.
- Krzywinski, M.**, Altman, N. & Blainey, P. (2014) Points of Significance: Two factor designs. *Nature Methods* **11**:1187-1188.
- Krzywinski, M.**, Altman, N. & Blainey, P. (2014) Points of Significance: Nested designs. *Nature Methods* **11**:977-978.
- Blainey, P., **Krzywinski, M.** & Altman, N. (2014) Points of Significance: Replication. *Nature Methods* **11**:879-880.
- Krzywinski, M.** & Altman, N. (2014) Points of Significance: Analysis of Variance and Blocking. *Nature Methods* **11**:699-670.
- Krzywinski, M.** & Altman, N. (2014) Points of Significance: Designing Comparative Experiments. *Nature Methods* **11**:597-598.
- Krzywinski, M.** & Altman, N. (2014) Points of Significance: Non-parametric tests. *Nature Methods* **11**:467-468.
- Krzywinski, M.** & Altman, N. (2014) Points of Significance: Comparing Samples — Part 2 — Multiple testing. *Nature Methods* **11**:355-356.
- Krzywinski, M.** & Altman, N. (2014) Points of Significance: Comparing samples — Part 1 — t-tests. *Nature Methods* **11**:215-216.
- Krzywinski, M.** & Altman, N. (2014) Points of Significance: Visualizing samples with box plots. *Nature Methods* **11**:119-120.
- Krzywinski, M.** & Altman, N. (2013) Points of Significance: Power and sample size. *Nature Methods* **10**:1139-1140.
- Krzywinski, M.** & Altman, N. (2013) Points of Significance: Significance, P values and t-tests. *Nature Methods* **10**:1041-1042.
- Krzywinski, M.** & Altman, N. (2013) Points of Significance: Error bars. *Nature Methods* **10**:921-922.
- Krzywinski, M.** & Altman, N. (2013) Points of Significance: Importance of being uncertain. *Nature Methods* **10**:809-810.
- Krzywinski, M.** & Cairo, A. (2013) Points of View: Storytelling. *Nature Methods* **10**:687-687.
- Krzywinski, M.** & Savig, E. (2013) Points of View: Multidimensional Data. *Nature Methods* **10**:595-595.
- Krzywinski, M.** & Wong, B. (2013) Points of View: Plotting symbols. *Nature Methods* **10**:451.
- Krzywinski, M.** (2013) Points of View: Elements of visual style. *Nature Methods* **10**:371.
- Krzywinski, M.** (2013) Points of View: Labels and callouts. *Nature Methods* **10**:275.
- Krzywinski, M.** (2013) Points of View: Axes, ticks and grids. *Nature Methods* **10**:183.

Altschul S, Demchak B, Durbin R, Gentleman R, **Krzywinski M.** *et al.* (2013) The anatomy of successful computational biology software. *Nat Biotechnol* 31: 894-897.

Publications—Book Chapters

Krzywinski, M. Scientific data visualization: Aesthetic for diagrammatic clarity. Chapter 3 in *Scientific Data Visualization: Aesthetic for Diagrammatic Clarity. More Than Pretty Pictures* (2017) Edited by Rikke Schmidt Kjærgaard & Lotte Philipsen. Routledge, NY.

Honaas, L, Altman, N, **Krzywinski M.** Study design for sequencing studies. *Methods in Statistical Genomics*. 1st ed Springer. (2016) *Methods Mol Biol.* 1418:39-66.

Chun HJE, Khattra J, **Krzywinski M**, Aparicio SA, Marra MA (Dellaire GD, Berman JN, Arceci RJ. editors). *Cancer Genomics*. 1st ed. Elsevier; 2013.

Krzywinski M, Corum J, Patterson K. Chapter 1: Visualization Principles for Scientific Communication. *Visualizing Biological Data – A Practical Guide*. Editors: Seán I. O'Donoghue & James B. Procter. Cambridge University Press. *In production*.

Schein JE, **Krzywinski M**. Part 2: Genomics. 2.2 Mapping. Fingerprint mapping. *Encyclopedia of Genetics, Genomics, Proteomics and Bioinformatics*. Editors: Lynn Jorde, Peter Little, Mike Dunn, Shankar Subramaniam.

Sossi V, Holden JE, Chan G, **Krzywinski M**, Stoessl AJ, Ruth TJ. Measuring the BP of four dopaminergic tracers utilizing a tissue input function. *Physiological Imaging of the Brain with PET*. Editors Gjedde, Hansen, Moos-Knudsen. 2001;131-137.

Publications—Preprints

Publications—Magazines

Krzywinski M, Schemaball: A New Spin on Database Visualization. *SysAdmin Magazine*. 2004; 13(8): 23-28.

Krzywinski M, Clusterpunch: Distributed Cluster Resource Monitoring. *SysAdmin Magazine*. 2003; 12(7): 24-29.

Krzywinski M, Butterfield YS. Sequencing the SARS Virus. *Linux Journal*. 2003; (115): 44-54.

Krzywinski M, Port Knocking: Look Ma – No ports! *Linux Journal, web edition* 2003; (<http://www.linuxjournal.com/article.php?sid=6811>)

Krzywinski M. Port Knocking: Network Authentication Across Closed Ports. *SysAdmin Magazine*. 2003; 12(6): 12-17.

Krzywinski M. Picking Cluster Parts: Cluster Construction at the Genome Sequence Centre. *login: The Magazine of USENIX and SAGE*, 2001; 26:36-44.

Invited Presentations & Lectures

Visualization of Biological Data—Crossroads. Schloss Dagstuhl - Leibniz-Zentrum für Informatik GmbH, Saarbrücken, Germany. 15–20 April 2018.

The Australian Poultry Science Symposium (APSS). Sydney, Australia. 4–7 February 2018.

Visualization workshop. 4th Canadian Conference on Epigenetics: Mechanisms of Disease. Whistler, Canada. 26–29 November 2017.

Visualization workshop. Boehringer Ingelheim Fonds. Mainz, Germany. 19–24 November 2017.

Visualization workshop. iNANO Autumn School. Himmerland, Denmark. 6–8 October 2017.

Visualization workshop. Spetses Summer School. Spetsai, Greece. 24 September–1 October 2017.

Scalable Set Visualization. Schloss Dagstuhl - Leibniz-Zentrum für Informatik GmbH, Saarbrücken, Germany. 13–18 August 2017.

Bioinformatics and Genome Analysis Course. Centre for Research & Technology – Hellas. Thessalonica, Greece. June 5–17 2017.

Visualization workshop. UBC & CIHR Skin Research Day. 16 Mar 2017.

Visualization workshop. Boehringer Ingelheim Fonds. Banbury Center, Cold Spring Harbor Labs. Feb 25 – Mar 1, 2017.

Improving Your Visual Science Communication: Plots & Figures. Westgrid Workshop. 8 February 2017.

Essentials of Data Visualization: Thinking about drawing data and communicating science. MBB462. Simon Fraser University. 24 Jan 2017.

Keynote. UCD Computational and Molecular Biology Symposium, Dublin, Ireland. 2 December 2016.

Visualization lecture. VizUM, University of Miami, Florida. 10 November 2016.

Visualization lecture. Central European Institute of Technology, Brno, Czech Republic. 4 October 2016.

Thinking Scientifically. SCIE 113. University of British Columbia. 22 September 2016.

Visualization workshop and lectures. University of Sydney, Australia. 23–31 August 2016.

Visualization lecture. University of Ankara, Turkey. 12 August 2016.

Seeing Networks Change. CANHEIT-HPCS2016 Conference: Shaping the Digital Landscape, Edmonton, 22 JUNE 2016.

Sense and Sensibility—Visual Design Principles for Scientific Data. CANHEIT-HPCS2016 Conference: Shaping the Digital Landscape, Edmonton, 21 June 2016.

The Quality of Quantity. University of Washington Free Public Lecture. University of Washington, Seattle. 21 April 2016.

Data Science Seminar—Seeing networks change. University of Washington, Seattle. 20 April 2016.

Creating better scientific figures. Western Washington University, Bellingham. 7 April 2016.

Fraser lecture series: The Big Data Revolution in Human and Environmental Health. Mt Baker Theater, Western Washington University, Bellingham. 6 April 2016.

B.I.G. Retreat 2016: Art and Science of Data Visualization Workshop. UBC. 11 March 2016.

Visual design principles for scientific data. Ecoscope seminar. UBC. 7 March 2016.

Bioinformatics and Genome Analysis Course. Izmir International Biomedicine and Genome Institute, Izmir, Turkey. May 2–14, 2016.

Thinking Scientifically. SCIE 113. University of British Columbia. 21 January 2016.

Visual Design Principles for Scientific Data workshop. Brain and Mind Symposium. Långvik Congress Center, Kirkkonummi, Finland. 17–18 September 2015.

Visual Design Principles for Scientific Data workshop. Bactory Summer School—Skills Beyond Science. Copenhagen, Denmark. 17–19 August 2015.

Seeing Networks Change (keynote). Arts, Humanities, and Complex Networks. 6th Leonardo satellite symposium. NetSci2015. Zaragoza, Spain. 2 June 2015.

Visual Design Principles for Scientific Data workshop. PhD programme retreat, Vienna Biocenter. Vienna, Austria. 28–30 May 2015.

Visual Design Principles for Scientific Data. Research Institute for Molecular Pathology. Vienna, Austria. 27 May 2015.

Visual Design Principles for Scientific Data workshop. Aarhus Institute of Advanced Studies, Aarhus, Denmark. 13 April 2015.

More Than Pretty Pictures—The Aesthetics of Scientific and Artistic Data Representation (keynote). Aarhus Institute of Advanced Studies, Aarhus, Denmark. 13–16 April 2015.

Visual Design Principles for Scientific Data (keynote). BiVi annual meeting. Edinburgh, Scotland. 16–17 December 2014.

AGTA Australasian Genomic Technologies Association Conference. Melbourne, Australia. October 2014.

Visual Design Principles for Scientific Data workshop. VLSCI. Melbourne, Australia. 14 October 2014.

Visual Design Principles for Scientific Data. Walter & Eliza Hall Research Institute. Melbourne, Australia. 13 October 2014.

Visual Design Principles for Scientific Data. Peter MacCallum Cancer Center. Melbourne, Australia. 13 October 2014.

Sense and Sensibility. Illumina webinar. Melbourne, Australia. 13 October 2014.

Seeing Networks Change. Australian Bioinformatics Conference (ABiC). Melbourne, Australia. 11–12 October 2014.

Communicating Science to Scientists. Melbourne Brain Center. Melbourne, Australia. 10 October 2014.

Visual Design Principles for Scientific Data. Post-graduate master class. VLSCI. Melbourne, Australia. 10 October 2014.

What Does Art Have To Do With Science. ICT for Life Sciences Forum. Public lecture. University of Melbourne Law School. Melbourne, Australia. 9 October 2014.

EMBO Global Exchange Lecture Course on High-throughput/NGS applied to infectious diseases. Institut Pasteur de Tunis. Tunis, Tunisia. September 2014.

WEST Water and Environment Student Talks. Vancouver, British Columbia. June 2014.

Bioinformatics and Comparative Genome Analysis. Pasteur Institute, Athens, Greece. May 2014.

Health Data Linkage Conference. Vancouver, British Columbia. April 2014.

Hereditary Cancer Program Rounds, BCCA, Vancouver, British Columbia. April 2014.

Collaborative Universities Biomedical Education Network Annual Conference. Canberra, Australia. December 2013.

Wired Health Data|Life Conference. New York City, New York. September 2013.

ICOP International Congress of Prositology. Vancouver, British Columbia. August 2013.

Bioinformatics Training Program and the Integrated Oncology Program Retreat. Vancouver, British Columbia. April 2013.

VizBi (keynote), Cambridge, Massachusetts. March 2013.

University of Virginia Biotechnology Training Program Symposium. Charlottesville, Virginia. Nov 2013.

Bloomberg Design Conference. San Francisco, California. Jan 2013.

ICDM International Conference on Data Mining (keynote). Brussels 2012.

Schloss Dagstuhl Seminar on Biological Data Visualization. Saarbrucken, Germany. Sept 2012.

Bioinformatics and Comparative Genome Analysis Course. Pasteur Institute, Naples, Italy. May 2012. Visualizing Genomes with Circos.

Visualization Principles. Visualizing Biological Data (Vizbi) 2012. Heidelberg, Germany. Mar 2012.

Behind Every Great Visualization is a Design Principle. Bioinformatics & Computational Biology Seminar Series, Iowa State University. Ames, Iowa. Feb 2012.

Bioinformatics and Comparative Genome Analysis Course. Pasteur Institute, Paris, France. June 2011. Visualizing Genomes with Circos.

Designing Effective Visualization in the Biological Sciences & Circos and Hive Plots: Challenging visualization paradigms in genomics and network analysis. PSA Annual Meeting 2011 Genomics Workshop. University of Washington. July 2011.

Bioinformatics and Comparative Genome Analysis Course. Pasteur Institute, Paris, France. July 2010. Visualizing Genomes with Circos.

Media—Covers, Interviews and Articles

Pi in the Sky: elegant new visualization maps the digits of pi as a star catalogue. *Scientific American SA Visual*. <https://blogs.scientificamerican.com/sa-visual/pi-in-the-sky/>

Chatzigeorgiou, K. (Jan–Feb 2017). Designing π . *Prime Magazine*. Aristotle University of Thessaloniki. <http://the-prime-magazine.math.auth.gr/data/documents/teukhos-3.pdf>

Thatra, N. On the origins of scientists. *The Ubbyssey*. November (2016).

Webb, S. The Art of Big Data. *BioTechniques* (2016) 61:107–112

Accelerator. Magazine of the Multiple Myeloma Research Foundation. Summer 2016

Marx, V. Data Visualization: Ambiguity as a Fellow Traveler. *Nature Methods* (2013) 10:613–615. UCSF Magazine. Fall 2013.

Nature Reviews Cancer Calendar. 2013.

Trends in Genetics. October 2012.

PNAS 109(18). May 2012.

EMBO Journal. 28(9) May 2009.

iGenetics: A Molecular Approach. 3rd ed. 2009

Media—Illustrations

Fischetti, M. The Bacteria Game. Graphic Science, *Scientific American*. December 2015.

Maron, D.F., A Road Map to the "Volume Control" of Genes. Graphic Science, *Scientific American*. June 2015.

Wong, K., Tiny Genetic Differences between Humans and Other Primates Pervade the Genome. Graphic Science, *Scientific American*. September 2014. (bronze medal, Malofiej 23).

Kolata, G. Cancers Share Gene Patterns, Studies Affirm. *New York Times* 1 May 2013.

Kolata, G. A New Treatment's Tantalizing Promise Brings Heartbreaking Ups and Downs. *New York Times* 8 July 2012.

Gorman, J. Ome—the Sound of the Scientific Universe Expanding. *New York Times* 3 May 2012

Aigner W, Miksch S, Schumann H et al. (2011) Visualization of Time-Oriented Data Springer-Verlag New York Inc.

Haynes H. Getting Lost. *Wired* 2010

Keim B. Beyond the Genome. *Wired* 2009

Zimmer C. Now: The Rest of the Genome. *New York Times* 10 November 2008

Constantine, D. Close-Ups of the Genome, Species by Species by Species. *New York Times* 23 January 2007

Public Art and Science Projects

Difference of One. BG Genomics Art exhibit. AGBT 2017. <http://mkweb.bcgsc.ca/agbt2017/>
Smithsonian Genome Zone. Washington, DC. Summer 2014.

Beautiful Science. British Library. Feb–May 2014.

Rudnik, J., **Krzywinski, M**, de la Cruz, A. Interactive art piece and film short of the data and lives behind BRCA mutations. June 2013. <https://www.youtube.com/watch?v=CDZy3zod6XE>.

Max Planck Science Gallery. Science Tunnel. 2012.

Max Planck Gallery Science Express. 2009.