Developmental and Reproductive Toxicant Identification Committee Meeting

October 18, 2022

Selected References and Additional Informational Materials for the Session on Use of Zebrafish Data in Developmental and Reproductive Toxicity Health Hazard Assessment

The October 18, 2022 meeting of the Developmental and Reproductive Toxicant Identification Committee (DARTIC) will include a session on the use of zebrafish data in developmental and reproductive toxicity health hazard assessment. The session will include presentations by four invited speakers: Dr. Bruce Draper, University of California Davis; Dr. Stephanie Padilla, US Environmental Protection Agency; Dr. Jennifer Panlilio, Woods Hole Center for Oceans and Human Health; and Dr. Dan Wagner, University of California San Francisco. Below is a selected list of references and additional informational materials that provide useful background information for this session, arranged by presentation. Additional background materials are listed at the end, and include the two most recent hazard identification documents considered by the DARTIC, both of which summarized findings from studies conducted in zebrafish.

Part I. Zebrafish biology and suitability for toxicity screening

Background Information Relevant to Presentation by Dr. Bruce Draper

Kossack, M. E., & Draper, B. W. (2019). Chapter 4 - Genetic regulation of sex determination and maintenance in zebrafish (Danio rerio). In B. Capel (Ed.), *Current Topics in Developmental Biology* (Vol. 134, pp. 119-149): Academic Press. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6894417/

Kossack, M.E., High, S.K., Hopton, R.E., Yan, Y.L., Postlethwait, J.H. & Draper, B.W. (2019) Female Sex Development and Reproductive Duct Formation Depend on Wnt4a in Zebrafish. Genetics 211, 219-233. https://pubmed.ncbi.nlm.nih.gov/30446521/

Liu, Y., Kassack, M.E., McFaul, M.E., Christensen, L.N., Siebert, S., Wyatt, S.R., Kamei, C.N., Horst, S., Arroyo, N., Drummond, I.A., Juliano, C.E., Draper, B.W. (2022) Single-cell transcriptome reveals insights into the development and function of the zebrafish ovary. eLIFE. 11: https://pubmed.ncbi.nlm.nih.gov/35588359/

Background Information Relevant to Presentation by Dr. Stephanie Padilla

Padilla, S. (2013). Chapter 20 - Zebrafish development: high-throughput test systems to assess developmental toxicity. In P. Steinberg (Ed.), *High-throughput screening methods in toxicity testing* (pp. pp 371-383): John Wiley & Sons.

https://doi.org/10.1002/9781118538203.ch20
Padilla, S., et al. (2022). Chapter 13 - Using zebrafish to assess developmental neurotoxicity. In R. C. Gupta (Ed.) *Reproductive and Developmental Toxicology (Third Edition)*., Academic Press: 239-251. https://doi.org/10.1016/B978-0-12-382032-7.10015-3
Thessen, A. E., Marvel, S., Achenbach, J. C., Fischer, S., Haendel, M. A., Hayward, K., . . . Hamm, J. (2022). Implementation of Zebrafish Ontologies for Toxicology Screening. *Frontiers in Toxicology, 4*. https://doi.org/10.3389/ftox.2022.817999

Additional Materials

Padilla, Stephanie (2012): Toxicity Screening using Zebrafish Embryos: Form and Function. Slide presentation (pdf). https://www.epa.gov > padillasept28presentation

Padilla, Stephanie (2021): Larval Zebrafish Neurodevelopmental Toxicity Testing and Variables That May Affect the Outcome. The United States Environmental Protection Agency's Center for Computational Toxicology and Exposure. Slide presentation. https://doi.org/10.23645/epacomptox.16879273.v1

Part II. Beyond screening: zebrafish as a model for developmental mechanisms at the cellular and molecular levels

Background Information Relevant to Presentation by Dr. Jennifer Panlilio

Panlilio, J. M., Aluru, N., & Hahn, M. E. (2020). Developmental Neurotoxicity of the Harmful Algal Bloom Toxin Domoic Acid: Cellular and Molecular Mechanisms Underlying Altered Behavior in the Zebrafish Model. *Environmental Health Perspectives, 128*(11), 1-19. https://doi.org/10.1289/EHP6652. Supplementary materials (video): https://ehp.niehs.nih.gov/doi/suppl/10.1289/EHP6652
Panlilio, J. M., Jones, I. T., Salanga, M. C., Aluru, N., & Hahn, M. E. (2021). Developmental Exposure to Domoic Acid Disrupts Startle Response Behavior and Circuitry in Zebrafish. *Toxicological Sciences, 182*(2), 310-326. https:doi.org/10.1093/toxsci/kfab066 Supplementary materials (pdf) linked to: https://academic.oup.com/toxsci/article/182/2/310/6294322#283781131

Background Information Relevant to Presentation by Dr. Dan Wagner

Wagner, D. E., & Klein, A. M. (2022). Lineage tracing meets single-cell omics: opportunities and challenges. *Nature Reviews Genetics, 21*(7), 410-427. https://doi.org/10.1038/s41576-020-0223-2
Wagner, D. E., Weinreb, C., Collins, Z. M., Briggs, J. A., Megason, S. G., & Klein, A. M. (2018). Single-cell mapping of gene expression landscapes and lineage in the zebrafish embryo. *Science, 360*(6392), 981-987. https://doi.org/10.1126/science.aar4362

Additional Materials

Science Magazine (2018) YouTube video "Scientists take a gene-by-gene look at developing frogs and fish." https://youtu.be/3mCgHK-X6lE

Chen, L., Wang, Z., Gu, W., Zhang, X.-x., Ren, H., & Wu, B. (2020). Single-Cell Sequencing Reveals Heterogeneity Effects of Bisphenol A on Zebrafish Embryonic Development. *Environmental Science & Technology, 54*(15), 9537-9546. *[Example of single-cell sequencing used to study a developmental toxicant]* https:doi.org/10.1021/acs.est.0c02428

Additional Background Materials

Knudsen, T. B., Fitzpatrick, S. C., De Abrew, K. N., Birnbaum, L. S., Chappelle, A., Daston, G. P., . . . Zurlinden, T. J. (2021). FutureTox IV Workshop Summary: Predictive Toxicology for Healthy Children. *Toxicological Sciences, 180*(2), 198-211. https://doi.org/10.1093/toxsci/kfab013

National Research Council (NRC). (2000). Chapter 7 - Using Model Animals to Assess and Understand Developmental Toxicity. In *Scientific Frontiers in Developmental Toxicology and Risk Assessment. Committee on Developmental Toxicology, Board on Environmental Studies and Toxicology*. https://www.ncbi.nlm.nih.gov/books/NBK225677/

OEHHA (2019). *Evidence on the Developmental Toxicity of Cannabis (Marijuana) Smoke and Δ^9-THC.* Sacramento and Oakland, CA: Office of Environmental Health Hazard Assessment, California Environmental Protection Agency. Available at: https://oehha.ca.gov/media/downloads/crnr/cannabisdarthid100419.pdf [See for example: Executive Summary and Appendix Table 4.6]

OEHHA (2021). *Evidence on the Male Reproductive Toxicity of Perfluorononanoic Acid (PFNA) and Its Salts and Perfluorodencanoic Acid (PFDA) and Its Salts.* Sacramento and Oakland, CA: Office of Environmental Health Hazard Assessment, California Environmental Protection Agency. Available at: https://oehha.ca.gov/media/downloads/crnr/pfnapfdahid100121.pdf. [See for example: Executive Summary, Table 4.2.2, Table 4.3.1, Table 4.3.2, the second table in Section 5.2, and Table 5.3.1.]