Example Briefing Doc: Lehigh University Biological Sciences Faculty Research

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This document summarizes the main research themes and important findings of several Lehigh University Biological Sciences faculty members, based on excerpts from their online profiles.

Overall Themes:

- **Cellular and Molecular Mechanisms:** A strong focus permeates the department on understanding fundamental cellular processes, including DNA replication and maintenance, cell signaling, neuronal communication, and ribosomal function.
- **Evolutionary Biology:** Several researchers investigate evolutionary processes, including the origins of phenotypic diversity, the evolution of sleep behavior, and the genetic basis of adaptation to specific diets.
- **Model Organisms:** Research leverages a variety of model organisms including yeast, zebrafish, fruit flies, and mice, allowing for in-depth investigation and experimental manipulation.
- **Translational Potential:** While focused on fundamental biology, several projects have potential implications for human health, including understanding the basis of neurodevelopmental disorders, developing new strategies for mosquito control, and investigating potential risks to marine mammals.

Faculty and Research Highlights:

Bob Skibbens:

- **Focus:** DNA replication, chromosome cohesion, and genome maintenance.
- **Key Findings:** "Evidence obtained by the Skibbens lab and others suggest that the process of tethering together sister chromatids is coordinated with DNA replication fork and occurs in proximity to other forms of DNA chromatinizations that include histone deposition and condensin recruitment." (Skibbens research statement)
- **Funding:** Consistent NIH and NSF funding highlights the significance of his work.

David Zappulla:

- **Focus:** Telomerase RNA structure and function, telomere length maintenance, and cellular senescence.
- **Key Findings:** "I determined the secondary structure of the 1157-nt *S. cerevisiae* telomerase RNA while I was a postdoc and revealed that it functions as a flexible scaffold for the essential Est1 protein subunit." (Zappulla research statement)
- **Impact:** Publications in high-impact journals like *RNA* and *EMBO Journal* demonstrate the significance of his contributions.

Dylan Shropshire:

- **Focus:** Genetic basis of *Wolbachia*-induced cytoplasmic incompatibility (CI), a form of reproductive manipulation in insects.

- **Key Findings:** "We discovered that two genes that we called CI factors A and B (cifA and cifB) caused CI when expressed in testes (LePage et al. 2017 Nature)..." (Shropshire research statement). Shropshire's work uncovered the surprising finding that viral genes within *Wolbachia* directly control arthropod reproduction.
- **Significance:** His work is highly relevant to understanding *Wolbachia* biology and has implications for mosquito control strategies.

Gregory Lang:

- **Focus:** Evolutionary genetics, specifically focusing on genetic conflict and its resolution through experimental evolution in yeast.
- **Systems Studied:** Sexual conflict, gene drive, and the selfish yeast Killer virus.
- **Impact:** Publications in *Genetics* and *PNAS* showcase the rigor and importance of his evolutionary biology research.

Jennifer Swann:

- **Focus:** Hormonal and pheromonal regulation of male sexual behavior in hamsters, exploring the neural circuitry involved.
- **Techniques:** Combines behavioral studies with molecular and cellular approaches.
- **Contribution:** Early work identified brain regions involved in pheromone processing, contributing to our understanding of the neural basis of behavior.

Johanna Kowalko:

- **Focus:** Evolution of behavioral plasticity, specifically sleep plasticity in response to food availability in *Astyanax mexicanus* (Mexican tetra).
- **Approach:** Combines field studies of natural populations with laboratory investigations of the genetic basis of sleep.
- **Significance:** Addresses a fundamental question in evolutionary biology and uses an intriguing model system to understand how behavior adapts to environmental pressures.

Julie Haas:

- **Focus:** Electrical synapses, specifically their role in thalamic circuits and their connection to attentional processes.
- **Expertise:** Employs electrophysiological techniques to investigate synaptic strength and dynamics in neuronal networks.
- **Key Findings:** "We hypothesize that the strength of electrical synapses within this nucleus is key for the control of human attention to the world around us." (Haas research statement)

Julie Miwa:

- **Focus:** Cholinergic system regulation, specifically focusing on lynx genes that modulate nicotinic acetylcholine receptors.
- **Model System:** Genetically engineered mouse lines to study the role of lynx genes in complex neurobiological processes.
- **Key Findings:** Her work has demonstrated that lynx genes play a role in learning, plasticity, and anxiety responses.

Kathy Iovine:

- **Focus:** Developmental genetics and evolution of morphological traits in zebrafish, particularly fin development and regeneration.
- **Key Findings:** Has identified genes involved in fin outgrowth and has shown that mutations affecting fin morphology also impact behavior.
- **Contribution:** Her research provides insights into the genetic mechanisms underlying the evolution of physical traits and their behavioral consequences.

Linda Lowe-Krentz:

- **Focus:** Characterization of heparin receptors in vascular cells and their role in cell proliferation, migration, and angiogenesis.
- **Approach:** Uses biochemical and cellular techniques to dissect the signaling pathways involved in heparin receptor function.
- **Significance:** Has potential implications for understanding vascular biology and developing new therapies for wound healing and angiogenesis-related diseases.

Matthias Falk:

- **Focus:** Structure and function of gap junction membrane channels and development of bioactive glass scaffolds.
- **Expertise:** Combines biophysical and cell biological approaches to understand the role of gap junctions in intercellular communication.
- **Key Findings:** "We are interested in understanding how such complex signaling structures are biosynthesized, how they are structured, and how their function is regulated." (Falk research statement)

Michael Layden:

- **Focus:** Evolutionary developmental biology, specifically the role of the *NvashA* gene in neurogenesis in the starlet sea anemone (*Nematostella vectensis*).
- **Key Findings:** Showed that *NvashA* is an ancient component of the metazoan neural specification pathway and is regulated by Notch signaling.
- **Contribution:** Provides insights into the evolution of nervous systems and the conserved mechanisms underlying neurodevelopment.

Nathan Urban:

- **Focus:** Physiological and circuit mechanisms underlying olfactory system function, specifically neuronal reliability, plasticity, and coding.
- **Model System:** Uses the mouse olfactory system as a model to study how neurons encode, transform, and store information.
- **Key Findings:** Investigates the mechanisms of neuronal variability, the influence of experience on olfactory bulb circuitry, and the role of intrinsic biophysical diversity in neuronal coding.

Neal Simon:

- **Focus:** Hormonal regulation of aggression, particularly the role of androgens and vasopressin.
- **Model System:** Uses animal models to study the neural and endocrine mechanisms underlying aggressive behavior.
- **Key Findings:** His work has elucidated the hormonal pathways involved in both male and female aggression.

R. Michael Burger:

- **Focus:** Auditory processing in the vertebrate brain, investigating how cellular, synaptic, and systems-level properties contribute to sound localization and feature extraction.
- **Expertise:** Employs electrophysiological and anatomical techniques to study auditory circuits in the brainstem.
- **Key Findings:** Has made significant contributions to understanding the role of inhibition in auditory processing and the mechanisms underlying temporal precision in sound localization.

Shawn Burton:

- **Focus:** Neural coding in the mouse olfactory bulb, specifically the role of inhibitory circuits in odorant discrimination and parallel processing.
- **Approach:** Uses a combination of electrophysiology, imaging, and molecular techniques to study olfactory bulb microcircuits.
- **Contribution:** His research aims to elucidate how specific neural circuits contribute to the remarkable ability of the olfactory system to process complex odor information.

Vassie Ware:

- **Focus:** Ribosome heterogeneity and biogenesis in *Drosophila melanogaster*, and phage biology and genomics.
- **Key Findings:** Her work has shown that different ribosomal protein paralogues can lead to specialized ribosomes with distinct roles in translation regulation, particularly in spermatogenesis.
- **Phage Biology:** Investigates phage defense mechanisms, particularly in mycobacteriophages, with implications for phage therapy and biocontrol.

Wynn Meyer:

- **Focus:** Evolutionary genomics and the genetic basis of adaptation, particularly in mammals.
- **Current Project:** Investigating the genetic changes associated with repeated transitions to herbivory across mammalian evolution.
- **Key Findings:** His work has uncovered the genetic basis of convergent evolution in traits like blue eye pigmentation and has identified potential risks to marine mammals due to ancient gene losses.

This briefing document highlights the diverse research expertise within the Lehigh University Biological Sciences Department. Each faculty member is making significant contributions to their respective fields, advancing our understanding of fundamental biological principles and addressing questions with potential impacts on human health and the environment.