

DEPARTMENT OF INTERNAL MEDICINE  
COLLEGE OF MEDICINE

SUMMER RESEARCH OPPORTUNITIES FOR UNDERGRADUATE students

FOR APPLICATION YEAR: 2026

PROJECT TITLE: Genetic Toolkit for Pneumocystis: Characterizing Endogenous Promoter SequencesA. George Smulian, M.D., FIDSA, FACP,  
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Cincinnati, OH 45267-2827**Project Description**

Pneumocystis infections cause severe pneumonia in immunocompromised patients and remain a major source of illness and mortality worldwide. Progress has been limited because these fungi cannot be cultured or genetically modified with standard tools. The lab developed a system to deliver and express DNA in *Pneumocystis murina*, a mouse-specific fungal pathogen that serves as a surrogate model for the human-infecting *Pneumocystis jirovecii*. Using a specially engineered plasmid and extracellular vesicles as a natural delivery vehicle, new genes can be introduced and maintained inside this organism. This project tests a set of *Pneumocystis* promoter sequences, genetic "on switches" that control how strongly a gene is expressed. Students will create plasmid variants where different promoters drive a reporter gene, deliver them to *Pneumocystis*, and measure how active each promoter is by quantifying RNA levels with qPCR. The goal is to assemble a toolkit of promoters that span strong to weak activity, which is essential for future studies of gene function and drug resistance.