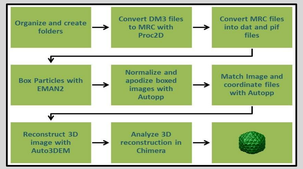
# Berkshire School 2014 INTEL STS Entrants from the AMSR Program

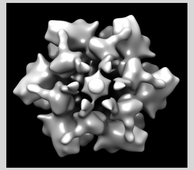
Hyun Suk (Jimmy) Chung, Olly Liu, Edeline Loh, and A. Elif Kesaf

## Hyun Suk (Jimmy) Chung ('14)

### CryoEM structure of MacK, a novel Mycophage isolated at Berkshire School

Abstract: Millions of people die from infection with *Mycobacterium tuberculosis* each year. Theoretically, phage exist that can infect and kill the bacteria that cause this horrible disease. Phage discovery and characterization will enable the development of this class of natural antimicrobials. The project's research goal is to structurally characterize novel phage of *Mycobacterium* in hopes of providing information needed to develop mycophages for phage therapy or alternatives to antibacterial treatments. A 26.31Å cryoEM structure of MacK, a mycophage isolated in an herb garden at Berkshire School, is presented herein. Additionally, the structure of a presumed subassembly of the MacK tail is presented. Structural studies such as these will provide necessary information for complete characterization of novel phage, the next generation of antimicrobial agents.



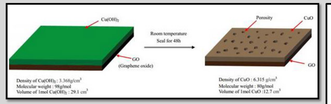



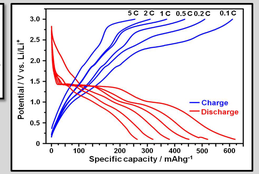
**Home: Seoul, South Korea**
**Fun facts: Loves digital**

## Olly Liu ('14)

### Synthesis of Graphene-supported Mesoporous CuO Nanosheets in Lithium-ion Batteries

Abstract: High capacity, better cycling and rate properties are crucial for high performance Lithium ion batteries (LIBs). Owing to the high theoretical capacity, transition metal oxides are promising potential anodes in the LIBs. However, the large volume variations during charge/discharge procedures limit their applications. Scientists are focusing on how to fabricate porous structures to overcome this crisis in current research and several new methods are reported but are relatively complicated, expensive or toxic in crafting. In this project, I created a novel way to construct graphene-supported mesoporous CuO nanosheets in a simple, cheap and environmentally-friendly condition. The CuO nanosheet contains pores with a diameter of 2-4 nm, spaced 10-20 nm apart on average. When compared with standard graphite anodes and non-porous CuO anodes, electrochemistry measurements reveal an excellent performance of my design. I also compared the sample with natural and modified graphite anodes, and observed a superior rate capability. This innovative method to fabricate porous structures of metal oxide crystals provides several advantages such as simple work-up procedure, shorter reaction time, milder conditions and environmental friendliness, and is suitable for large-scale fabrication.



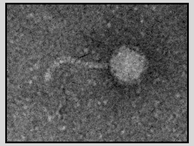




**Home: Shanghai,China**
**Fun fact: Excellent photographer**

## Edeline Loh ('14)

### The Discovery of a Novel Mycobacterium Phage: Edtherson for the Fight against Tuberculosis

Abstract: Tuberculosis is a potentially fatal bacterial disease that affects humans. Even through recent technological advances in the medical industry have been made, there are still millions of people are dying from Tuberculosis every year. Additionally, there is a huge need for a fast and inexpensive field test for tuberculosis which will help to save thousands of lives. Our goal was to discover a phage that infects *Mycobacterium smegmatis* which is a safe alternate to *Mycobacterium tuberculosis*, the bacteria that causes Tuberculosis. The research eventually led to the isolation of Edtherson from soil found in Berkshire School Campus located in Sheffield, Massachusetts. The structure and growth characteristics of Edtherson were determined. Then, experiments were conducted to study how temperature affects the attachment aspect of Edtherson. This research will help to develop novel therapeutics that can be administered in developing countries where tuberculosis is still a major health problem.



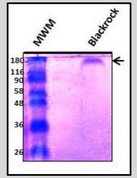
| | Efficiency (24°C) | Efficiency (37°C) | Efficiency (42 °C) |
|---|---|---|---|
| Trial 1 | (344/344) × 100% =100% | (304/344) × 100% =88.4% | (156/344) × 100% =45.3% |
| Trial 2 | (211/211) × 100% =100% | (192/211) × 100% =91.0% | (111/211) × 100% =52.6% |
| Trial 3 | (230/230) × 100% =100% | (199/230) × 100% =86.5% | (124/230) × 100% =53.9% |

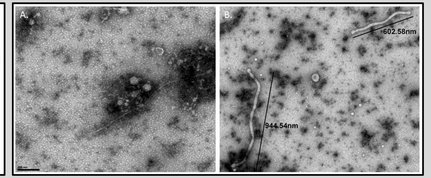
**Home: Singapore**
**Fun fact: Captain of the Varsity Golf Team**

## A. Elif Kesaf ('14)

### Blackrock Virus: A Novel Virus with Applications for the Treatment of *Legionella pneumophila*

Abstract: Antibiotic resistance is a rapidly growing problem all over the world. Previously curable diseases pose a threat to human health due to bacterial adaptation to antimicrobial drugs commonly used to prevent bacterial diseases. As a very first step to eliminate the problem of antibiotic resistance for *Legionella pneumophila*, the causative agent of Legionnaire's disease, a novel bacteriophage, named Blackrock, was isolated from soil and characterized. Surprisingly, the characterization of Blackrock indicated that it is a filamentous virus and may be capable of killing and lysogenizing its host. The potential application of Blackrock for patients and sources of disease such as air conditioning systems is very promising for the future treatment and prevention of Legionnaire's disease, respectively. Blackrock is also promising for the development of novel molecular tools and detection methods to study *Legionella pneumophila* mechanisms.




**Home: Yenisehir Mersin, Turkey**
**Fun Fact: Captain of the Varsity Volleyball Team**