



**CALIFORNIA STATE SCIENCE FAIR  
2009 PROJECT SUMMARY**

<b>Name(s)</b> <b>Kevin R. Kaufmann</b>	<b>Project Number</b>  29046
<b>Project Title</b> <b>Virus-Based Lithium Ion Batteries</b>	
<b>Objectives/Goals</b> This project was done to create fully functional nanowires that could be used as a battery electrode. An objective is that the synthesized nanowires be uniform in structure. <b>Abstract</b> <b>Methods/Materials</b> A bacteriophage (a virus that specifically infects bacteria) is used as a template for creating precisely positioned materials. The bacteriophage becomes a template when the functionality of certain proteins are changed through genetic modifications in the M13 bacteriophage's genome. Because of the addition of a tetraglutamate to a specific protein, FePO <sub>4</sub> will bind to the phage. The resulting clone is named E4. <b>Results</b> The nanowires formed by binding FePO <sub>4</sub> to the E4 phage are more environmentally friendly and less costly to make than existing FePO <sub>4</sub> battery components. The FePO <sub>4</sub> /E4 battery is almost completely biodegradable also. The only part of the battery not biodegradable is the electrolyte. The virus-based batteries could hold any voltage, except that the electrolyte for lithium ion batteries is only stable from approximately 1 volt to 5 volts. The virus-based batteries are also rechargeable, meaning they are not just one use. <b>Conclusions/Discussion</b> These virus-based batteries are both environmentally friendly and economical. They will last longer than other commercially available batteries and help to create less waste for the future. The nanowires can be used to build batteries applicable to most aspects of life requiring a power source.	
<b>Summary Statement</b> Genetically modifying a bacteriophage to produce nanowires for a battery electrode.	
<b>Help Received</b> Used lab equipment at Massachusetts Institute of Technology under the supervision of Professor Angela Belcher and Mark Allen PhD.; Neighbor Eric Acree helped with wire display; photos taken by Diane M. Kaufmann	